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SIR CHARLES BELL: THE MAN AND HIS WORK.*

By Eugene R. Corson, M. D., Savannah, Ga.

Veniet tempus quo ista quæ nunc latent, in lucem dies extrahet, et longioris ævi diligentia. Veniet tempus quo posteri nostri tam aperta nos nescisse mirabuntur.

A careful study of an ordinary human life is not without interest and brings with it at times a deep lesson. And when a life happens to be that of genius, of one who, in his time and generation, stood out in bold relief, and who left us the products of his genius to be admired and wondered at, its study becomes indeed of absorbing interest.

There has been a tendency for some years to dwell upon the dark side of genius (if there is such a side), to study the eccentricities and morbidities which have attended certain forms of genius. Minute studies have been made of mental and physical stigmata in the hope of following the radiance to its source, but I have failed to see that any light has come from this work. It has been a quest of epiphenomena alone. There is a notable example of this in a large work by Max Nordau, entitled "Degeneration," in which this writer has brought together with an interminable analysis all the cases he could find of any perversions, eccentricities, or insanities connected with genius in any form. The genius itself was not only placed in the background, while insanity or degeneration stood boldly in the front, but the writer has failed to give us the slightest guiding thread that we could follow up.

It is well for the world that genius compels its full recognition and acceptance, though these be at times delayed, and that, whatever morbid or eccentric accompaniments there may be, they pertain to the outer man, while the real radiance of genius itself shines steadily on with undiminished splendor.

But a greater than Max Nordau, namely, F. W. H. Myers, who was himself a genius, has given us a truer and loftier conception of the divine gift. He who would learn more of the absolute character of genius should make a careful study of that great chapter on the subject in his "Human Personality." He would get a point of view which would illumine the dark passages through which genius may at times have had to pass; he would better understand genius as in a way apart from the mere discursive intellect, an "uprush" from

* Paper read before the Johns Hopkins Hospital Historical Society, December 13, 1909.

the diviner self, and *sufficient unto itself;* and he would better understand what seemed incomprehensible before—the functioning and life of this deeper and greater self. What to Nordau were the intimate and inseparable associates of genius will now be seen to be things apart from it, and standing in the way of the roseate glow of its morning and the clear white light of its high noon.

The subject of our present sketch shows us a harmony, an equipoise of the moral, emotional, and intellectual man quite as rare as the quality of his genius. I have looked in vain into the sources at my disposal for the disturbing factors to the full play of his powers. On the contrary, I found a deep religious nature, great optimism with great confidence in self, an artistic temperament with a critical and philosophical faculty, a keen appreciation of literature and poetry, a capacity for great affection and love of family, with ambition and high ideals, and great energy and industry; and, as a basis for all these qualities, an absorbing passion for the study of structure, of anatomy, human and comparative, with the genius of the naturalist for observation—all marshaled around his one great, absorbing study, the work of his life, the making of a great anatomist and surgeon.

His genius ranks him with the great observers of nature, wholesome, finely poised, of simple living and high thinking. The faithful study of nature seems to lead to a certain calm happiness and contentment. The eagerness and joy of observation, the joy of discovering the causes of things seems to transcend all else, be the quest in the woods and fields, or within the closed walls of a laboratory or dissecting room. Of this the life of Charles Bell gives us abundant evidence.

Charles Bell's grandfather was a Mr. John Bell, minister of Gladsmuir, who was born on February 2, 1676. He was noted for his industry, determination, and impressive eloquence. He was called upon to preach the sermon on the death of William III before the General Assembly of the Church of Scotland. That he gained a reputation for a vigorous intellect before he was thirty shows him to have been a man of parts. He died at the early age of thirty-two, leaving several children, of whom William Bell alone comes into prominence as the father of Charles, and as a member of the Catholic and Apostolic Church of Scotland. To have left the Presbyterian Church, of which his father and family were members, and to have become a minister of the Episcopal Church of Scotland, at a time when that church was under many restrictions and persecutions, shows his independence and fearlessness. His first wife, surviving all her children, died in 1750. In 1757 he married Margaret Morice, the elder daughter of an Episcopal clergyman. Early left an orphan, she was educated by her grandfather, Bishop White, afterwards Primus of Scotland. She was distinguished for her piety and many accomplishments, among which was a great talent of drawing which she transmitted to her children. It was in her youngest son, Charles, that this talent of the family culminated.

William Bell died on September 20, 1779, aged 75 years, leaving a wife and six children very slenderly provided for.

In memoranda jotted down by George Bell, the fourth son, and most beloved brother of Charles, and who afterwards rose to distinction as a jurist and professor of law in the University of Edinburgh, we read:

"My mother was a most excellent woman, well educated, and of sweet disposition. Left with a large family of children, she struggled with great virtue and fortitude against distresses which I did not at the time understand, but cannot now call to mind without bitter regrets and sorrow. In myself and my dear brother Charles she had her greatest comfort in her later days. . . . . This is a consolation to me which the wealth of worlds would not induce me to forfeit. Our circumstances were so narrow that my education was much stinted—the rest of the family expenses having gradually increased so that my schooling, which required no more than five shilling a quarter, could not be continued after I was eleven years old."

Charles's description of his mother shows her to have been a remarkable woman, gifted in many ways, of great nobility of character, the worthy mother of distinguished sons. Of her six children three reached distinction: John Bell, the anatomist and surgeon; George Joseph Bell, professor of the law of Scotland in the University of Edinburgh; and most distinguished of all, her youngest son, Charles.

Between George and Charles there existed a brotherly love which is hardly to be paralleled in history. For nearly forty years, at short intervals, they kept up an intimate and affectionate correspondence. Each wrote to the other as his *alter ego*, and from the letters of Charles which have been preserved we have a *journal intime* which gives us a clear and detailed picture of the man and his work. It is from these letters that I have been enabled to learn what manner of man he was. From November, 1804, when he went to London, until August, 1836, when he returned to Edinburgh, we can follow him in his work and in his rise to fame; we may know the motives which prompted him, the emotions which stirred him; we may know how he viewed his fellow man and how he treated him. In my search I found nothing unworthy of a noble character. Linked with a life-long serious work, of great industry and great endeavor, of a sustained interest and an enthusiasm which never flagged, we find an almost boyish cheerfulness and freshness of emotion as bright and cheery as a May morning.[1] And in the last years of his life he went a-fishing, whenever he could get a holiday, with all the ardor

[1] In Pichot's Life of Sir Charles Bell, he gives the impression of a melancholy and even misanthropic nature at times, especially in the last years at Edinburgh, when income did not keep step with honors and position and their responsibilities. He evidently got his impression from stray thoughts in the correspondence. It would be impossible to imagine an intense nature like Sir Charles Bell's without an occasional swing of the pendulum towards depression,—almost a normal reaction or relaxation from the accustomed high tension. Sir Charles Bell's family and friends protested against this view as absolutely false; and Lord Cockburn, a most intimate friend, wrote to Lady Bell: "If I ever knew a generally and practically happy man, it was Sir Charles Bell."

And Lord Jeffrey, a very close friend of Sir Charles, wrote to Lord Cockburn on hearing of his death: "This is a sad blow, the loss of good, kind-hearted, happy Charlie Bell."

of a boy. Verily, we have much to learn from this man quite aside from his new physiology of the nervous system.

Charles Bell was born in November,[2] 1774, and was but five years old when his father died. Years afterwards he wrote:

"I received no education but from my mother, neither reading, writing, cyphering, nor anything else. My education was the example set me by my brothers. There has been, in my day, a good deal said about education, but they appear to me to put out of sight *example*, which is all in all. There was in all the members of the family a reliance on self, a true independence, and by imitation I obtained it. . . . .

"When I look back to those days my affection centers in my mother, and in my dear brother, George. Yet Robert was most kind to me. I was his playfellow and pet.

"My first recollections are as a little boy, by my mother's side. I recollect the dining-room, the view south, the mild affection with which she would stop her wheel, or point the letters (of my lesson) with her stocking-wire.

"I must have been either wise or cunning in those days, for having offended her, I did not attempt reconciliation all at once, but I watched her out, and presented myself to her whilst picking her way in the crowded street, when her open arms and benevolent smile received me. . . . .

"She must have been well educated for her time. I know no more of the motions of the earth, moon, and stars, than her little contrivance then taught me as a boy. I recollect the room and the spot where she formed a ball, and passed a stocking-wire through it to show me the poles and the revolutions of the seasons, and gave me the first idea of a truth which the mere senses could not convey, the motion of all which seemed stationary in the diurnal and annual motions of the earth.

"The education at the high school, which I attended for two years, was to me torture and humiliation. Adams, loved by all good scholars, was to me a stupid tyrant. I can remember brightening on the display of Cæsar's Bridges over the Rhine. Anything demonstrative or mechanical, or tending to Natural Philosophy, I comprehended better than my companions; but the memory of verses or Latin rules, without intellectual comprehension of some principles, I was almost incapable of. . . . .

"Memory should be cultivated. It bestows great advantages. Mine was ever deficient. I could not, and cannot venture on a quotation either in conversation or in public discourse. Quotation directed with good taste, gives interest and elegance; but memory, without the direction of sound judgment, is a poor substitute for reason."

We have evidence that he was a good Latin scholar. His "Anatomy of Expression" has many quotations from classic Latin writers. In one of his letters to his brother, he writes: "I have within the last few days read the whole of the Æneid, and have scored some beautiful passages." And again: "I am reading Horace. The Ars Poetica is more worthy of the annotations of a painter than Du Fresnoy's Art of Painting." He got later French and Italian masters to read and speak with him, and he had a fairly free and easy knowledge of both these languages. His appreciation of poetry and literature in general was keen. He quotes repeatedly from Dante and Spencer, whose Faerie Queene was always a favorite with him. He saw in its beautiful imageries so many subjects for his pencil and brush.

His artistic talent which, as is usually the case, he showed as a child, he made use of in his anatomical and surgical studies to an extent and perfection which give a charm to-day to all his writings. His range was so great, from the detailed drawings of the most delicate and intricate dissections, from drawings of pathological specimens, to face and figure drawings illustrating human emotions and expressions. He worked equally well with the pencil, by etching, in water-color, or in oil, and he modeled in plaster and in wax. That he had good composition may be judged from his landscapes, and such pictures as "The Suter and the Sow" and "The Fisher." Examine any little bit of drawing in his surgery or anatomy and you will find the same care and delicacy of touch that you find in his more pretentious drawings. If he draws for you a probe passing under the fascia it is with a realism and an accuracy almost photographic. I am glad to see that this artistic method is being carried out to even greater perfection in our anatomical and surgical illustrations to-day, and if I mistake not, we owe much of this artistic revival to the publications emanating from the Johns Hopkins University, and from the pencil and brush of Max Brödel.

Of his early training he wrote:

"Allen, the painter, was a man very dear to me in my early boyhood. There was sunshine the afternoon he came to me. He was quite a man to a boy's humour. He was wont at all times to salute me, "Ha! Brother Brush, let's see what you have been doing!" To him I am very principally indebted for my pleasure in drawing. . . . . He gave me his very beautiful studies from the Antique, and from Raphael's cartoons, to copy, and was very good natured in his praise. I meet with these heads sometimes, and hail them as something very old and very melancholy sweet."

He was two years in the high school and two years in the University of Edinburgh before he took up seriously the study of medicine. As he himself admits, he did little or nothing to attract attention while at school. Such a mind as his is apt to be too independent and too much absorbed in its own line of thought to follow the set lessons of the schoolmaster.

That he had early mapped out his work and had started to carry it through we have abundant evidence of, for while a medical student he began his "System of Dissections." This was in the spring of 1797, when he was but twenty-three. My own copy of this work, two volumes bound in one, large folio, is dated 1799 on the title page of the first volume, 1800 on the title page of an appendix to Volume I, and 1803 as the date of the second volume. It is a remarkable work for a mere youth. The beautiful drawings of his dissections,[3] the clear descriptive text, the careful instructions of methods of work, show the maturity of genius. You see already the qualities which characterized his more mature and best work, especially his study of function with structure, structure always suggesting function to his mind. This quality was the keynote of all his discoveries and best work. He could not study anatomy without being a physiologist and a philosopher at the

[2] I have not been able to find the day of the month of his birth.

[3] One of the illustrations is his own etching, and a very creditable piece of work, representing an injected preparation of the breast.

same time.[4] He writes in the preface: "The object of this work is to serve as an assistant to the student in acquiring a knowledge of practical anatomy; in gaining a local memory of the parts; in learning to trace them upon the dead subject, and to be able to represent them to his own mind upon the living body. This being my object, the method to be pursued is obvious: to give a short detail of the anatomy; to show how the parts are to be laid open and how they are to be distinguished in dissection, or avoided in an operation; *to explain the consequence of each part to the great functions of the body;*[5] and to mark the diseases to which it is liable."

He has given us in this quotation the secret of a great anatomist, *i. e.*, "in gaining a local memory of the parts; in learning to trace them upon the dead subject, and to be able to represent them to his own mind upon the living body." No more appropriate words could be cut in stone over the doorway of an anatomical laboratory. You must be a good visualizer to be a good anatomist.

I think it is evident that Joseph Maclise, who published his admirable surgical anatomy in 1851, although a distinctly individual book, fashioned it in a general way after this work. Maclise's book is, to my mind, a more practical work to-day than many later books on the subject. The drawings, however, lack the artistic quality and charm of the older work. The comparison of the two is highly suggestive: there may be talent in the one, there is surely genius in the other.

Bell must have graduated in 1799, for on August 1 of that year he became a fellow of the Royal College of Surgeons of Edinburgh. This fellowship put him on the surgical staff of the Royal Infirmary, and in this position he gave evidence of his ability as a practical dissector and anatomist and surgeon, making his own beautiful drawings in his own inimitable way, and preparing anatomical, physiological and pathological specimens for the museum. He invented a method of making models of morbid parts which may still be seen in the museum of the college.

In 1802 he published a series of engravings of original drawings of the anatomy of the brain and nervous system from dissections made for the course in anatomy of his brother John. In 1804 he wrote Volume III of The Anatomy of the Human Body, by John and Charles Bell. The volume deals with the anatomy of the nervous system and the organs of special sense and of the viscera. Thus early was he preparing the way for his discoveries.

In 1804, by some new arrangement, Bell was excluded from the hospital, others getting the appointments by virtue of their seniority. He offered to pay the hospital £100 a year and to transfer to it the museum he had collected on condition that he be "allowed to stand by the bodies when dissected in the theatre of the infirmary, and to make notes and drawings of the diseased appearances." Strange to say, this proposal was rejected and he went to London in November, 1804, probably in large measure influenced by the advice of his brother George. Before he went to London he had largely written a work on "The Anatomy of Expression in Painting."[6] It was published two years later and at once attracted attention as an original and notable work on the subject.

In succeeding editions he added much to it, especially after his Italian journey in 1840, thirty-four years later, when he introduced many of his admirable notes on Italian Art and the Antique. From his letters it can be seen how carefully he made his illustrations. The subject was admirably adapted to his genius, embracing, as it did, the work of the anatomist, the philosopher, and the painter. His dissections of the facial muscles and nerves at once suggested their functions, and he eagerly sought to combine function with structure, and to work out, along artistic and psychological lines, the whole subject of human expression. His keen observation and subtile intuition carried him beyond the mere facial expression. He saw how large a part respiration took in the expression of the emotions, as well as the attitudes assumed by the entire body. This was evidently the basis of that greater study and discovery of the nerves of respiration which was soon to follow.

In the first essay on the form and proportions of the skull and bones of the face he showed how fallacious was the facial line of Camper and the method of Blumenbach in taking the frontal bone and the superior maxillary as a criterion of the development of the brain case. He offered as a better method the following:

> "To find a line which should not vary, but enable us to measure with correctness the angles both of the facial line, and of the line intermediate between the cranium and the face, I poised the skull upon a perpendicular rod, by passing the point through the foramen magnum into the interior of the skull, so that the upper part of the cranium rested on the point. By shifting the skull till the rod was exactly betwixt the condyles of the occipital bone, and in the center of the foramen magnum I procured the line which was wanted."

This was a distinct advance in craniology and in the proper estimate of the development of the head as a whole.

His chapter on the theories of ideal beauty shows a fine artistic feeling and knowledge of the history of art. In the chapters on expression in reference to the body he brought out the intimate connection of the respiration and the attitude

[4] We therefore find him using the comparative method as far as comparative anatomy at that time permitted. The great progress made in anatomical study since Bell's time has been based upon comparative anatomy, embryology, and the use of the microscope. I have looked in vain for any mention of the microscope in any of Bell's works. In his careful dissections of the brain and cord it would have seemed most natural had he pushed on his investigations by the use of all the magnifying power at that time obtainable; yet not once is the microscope mentioned, nor does any drawing show microscopic work. His gross anatomy seemed to him all sufficing.

[5] Italics mine.

[6] The title was changed in succeeding editions to "The Anatomy and Philosophy of Expression as Connected with the Fine Arts." The seventh edition appeared as late as 1893. He made many changes and additions especially after his Italian journey in 1840. Many Latin quotations and several striking illustrations were discarded and the work practically rewritten, so that the edition of 1844 is really a new work and shows how diligently he worked to improve his illustrations and his whole treatment of the subject.

Painted by Anthony Stewart, Edinburgh, 1804

SIR CHARLES BELL, AET. 30

From a posthumous bust by Theed

Charles Bell.

of the body with the facial expression. In the two concluding essays he showed the value of anatomy to the painter, and as necessary to design. The illustrations show some of the finest specimens of his pencil. Even in this day of many pictures you can pick out some worthy of reproduction and enlargement. Note the head of the laughing child which closes the Introduction, the merest sketch, yet full of charm. The book had a ready sale and added much to his reputation. In a letter of August 17, 1806, he wrote:

"My book, the Longmans say, moves off. Lynn says everybody talks highly of it, and it is the very thing. 'They don't understand it,' he adds, 'more than myself, but they admire it.'"

At this time he gave lectures to painters on artistic anatomy, teaching them by dissections and on the living model, and with his own beautiful models in clay and wax. Sydney Smith at this time wrote to Jeffrey:

"I hope to see more of your friend Bell. He is modest, amiable, and full of zeal and enterprise in his profession. I could not have conceived that anything could be so perfect and beautiful as his wax models. I saw one to-day which was quite the Apollo Belvedere of morbid anatomy."

It was soon after he came to London that he instituted his own private courses of lectures on anatomy, and later his surgical lectures and the operations of surgery on the cadaver. Many of his students were private pupils living in his own home with him and directly under his personal care. Teaching was ever a passion with him, and he fully realized the stimulation he got from it and its constant incentive to original research. He often referred to the joy of this work, and pointed with pride to the fact that he had educated in anatomy and surgery over eight hundred students.

In a letter of March 7, 1805, the year after he went to London, he wrote: "Longman made me an offer of £300 for two 8vo volumes introductory to surgery." This is good evidence of his progress and the recognition of his ability. The first edition was published in 1807, and the second in 1814. Though the book was evidently a "pot boiler," as the expression goes, and a task which took him away from more agreeable and profitable work, as he admits in his preface, it is a notable book, gives us a very clear and comprehensive view of surgery at that time, but, more important still, shows us his own qualities as a surgeon. As indicated on the title page, the work was a system of operative surgery *founded on the basis of anatomy*, carrying out what his brother John had already forcibly contended for and developed in his own practice. The idea marked a distinct advance in surgery; it was a change from blind cutting to careful dissection and more deliberate operating; it was an advance, however, which only the discovery of anæsthesia a few years after Bell's death thoroughly established and made possible under all circumstances. In no operation at the time was this position more clearly shown and developed than in that of lithotomy. It is very evident here that Bell's surgical acumen carried him ahead of his time. The gorget was still in use, and the operation, though an improvement over the wild, blind jab of Frère Jacques, was still haphazard. The unsurgical operation of Frère Cosme was still practised at the Westminster Hospital by well-known surgeons. Against the gorget and this latter operation Bell strongly contended, and argued for the operation with the knife, a deliberate incision through perineum and prostate, with a clear idea at every step where you are. The operation is very clearly described and the use of the knife illustrated by his characteristic sketches. He used three instruments, a large staff, a scalpel with a straight back, and the usual lithotomy forceps. He described this operation on a boy. "The boy was only three minutes and a few seconds on the table, and was entirely recovered in three weeks." In his description of the operation for hernia we are conscious of the same admirable judgment and surgical skill.

When M. Roux, the great French surgeon, returned home from a visit to London, he wrote:

"Charles Bell is one of the few Englishmen who operates like a Frenchman, quickly and with *grace*, without affectation."[1]

In a letter to his brother on November 26, 1807, he wrote:

"I have done a more interesting nova anatomia cerebri humani than it is possible to conceive. I lectured on it yesterday. I prosecuted it last night till one o'clock, and I am sure it will be well received."

This is the first written record we have of Bell's discovery. Of the great importance of this discovery he was well aware, for on November 31 he wrote:

"I really think this new Anatomy of the Brain will strike more than the discovery of the Lymphatics being absorbents."

On December 5, he wrote:

"My new Anatomy of the Brain is a thing which occupies my head almost entirely. I hinted it to you formerly that I was *burning*, or on the eve of a grand discovery.

"I consider the organs of the outward senses as forming a distinct class of nerves from the others. I trace them to corresponding parts of the brain, totally distinct from the origins of the others. I take five tubercles within the brain as the internal senses. I trace the nerves of the nose, eye, ear, and tongue to these. Here I see established connections. Then the great mass of the brain receives processes from these central tubercles. Again the greater mass of the cerebrum sends down processes or crura, which give off all the common nerves of voluntary motion, etc. I establish thus a kind of circulation, as it were. In this enquiry I describe many new connections. The whole opens up in a new and simple light; the nerves take a simple arrangement; the parts have appropriate nerves; and the whole accords with the phenomena of the pathology, and is supported by interesting views."

Up to the beginning of the nineteenth century there was no physiology of the nervous system properly speaking. Alexander Monro had discovered the ganglions on the posterior roots of the spinal nerves and not on the anterior. Santorini and Wrisberg had noted the two roots of the fifth pair. Pa-

[1] We have a delightful bit showing Roux's affection as well as admiration for Sir Charles in a letter from George J. Bell, Jr., who accompanied him to Italy. He writes to his father from Paris, May 21, 1840: "The way in which Roux and Petit received him was most amusing. When he put his card into his hand it was, 'Ah! Sharley Bell! C'est lui-même!' upon which all the students were gathered round, and the ward resounded with 'Sharley Bell.' He was, of course, much pleased."

letta, tracing the anterior root of the fifth pair to the muscles of the jaw, conceived it therefore to be a muscular nerve, yet it did not seem to lead him to any idea of the function of the larger sensory root.

Scarpa got no further than the question: "Is the posterior root a proper and peculiar kind of nerve, belonging exclusively to the spinal marrow, while the anterior root is a cerebral nerve?"

There was a generally accepted hypothesis that there was a nervous fluid circulating along the nerves, indifferently one way or the other, acting both for motion and sensation. Haller, after a long dissertation, concluded: "But I know not a nerve which has sensation without also producing motion." Bichat seems to have gone further when he recognized the sympathetic system, and which he called the ganglionic system, as a distinct system for vegetative life, with the cerebro-spinal system for the animal life of motion and sensation.

Thus advanced as the anatomy of the nervous system was there was no physiology in step with it until the genius of Bell discovered it. And I cannot in a way but look upon this discovery as greater than that of the circulation of the blood, for while Harvey had something more than mere whisperings of the truth to help him, Bell had nothing but his own great industry in dissection and anatomical knowledge, and patient investigation. But there was his genius which made for him the step from structure to function so easy and so natural. He wrote:

"The view which I have taken of the nerves has not been the result of hasty and premature conjecture, but of patient investigation. From the first year of my delivering lectures, my demonstrations of the brain were given in a manner not then common: and to this peculiarity in the manner in which I looked on the connections of the brain, I trace the origin of opinions different from those hitherto entertained. By the time I began to lecture in Windmill Street I was enabled to follow, in my demonstrations of the nerves, an arrangement which has given a new interest to the subject, and which, by imperceptible degrees and improvements from year to year, during every succeeding course of demonstration, has at length developed the comprehensive system which I have now to present to the reader.

"The steps by which I have cautiously advanced have been observed only by my older and more diligent pupils; who, becoming interested in the subject, have returned during successive years, when it was under consideration, to hear how I continued to prosecute it. They have seen the system gradually developed, and have heard me announcing the desiderata as the inquiry proceeded, and explaining the difficulties; and they have seen how the points which were in one season the most obscure, have by diligent investigation become those of the very highest interest in succeeding courses."

In the whole range of our science I know of no discovery which was the fruit of more patient investigation, I know of no better example of genius as an infinite capacity for taking pains.

Bell's physiology of the nervous system was finally given to the world in six papers presented to the Royal Society from the years 1821 to 1829, as follows: "On the Nerves," read July 12, 1821; a second paper, "On the Nerves of Respiration," May 2, 1822; a paper, "On the Motions of the Eye, etc.," March 20, 1823; second part of the paper, "On the Nerves of the Orbit," January 19, 1823; "On the Nervous Circle Which Connects the Voluntary Muscles with the Brain," February 16, 1826; and a paper, "On the Nerves of the Face," read May 28, 1829.

Briefly stated, Bell's new physiology consisted in the following propositions: He divided the nerves into those of the special senses, namely, smelling, seeing, hearing and tasting; the nerves of general sensation; the nerves of voluntary motion; those which have to do especially with the motions of respiration; and lastly the nerves constituting the sympathetic system, "which seem to unite the body into a whole, in the performance of the functions of nutrition, growth and decay, and whatever is directly necessary to animal existence."

That "the nerves are sometimes separate; sometimes bound together; but they do not in any way interfere with or partake of each other's influence."

That "the key to the system will be found in the simple proposition, that each filament or track of nervous matter has its peculiar endowment independently of the others which are bound up along with it; and that it continues to have the same endowment throughout its whole length."

That "a simple nerve is where the threads or *funiculi* which form its root arise in a line or sequence from the brain or spinal marrow. A compound nerve is where the threads forming the roots arise in double rows, and each row from a different column or tract of nervous matter; for example, the ninth nerve is simple; a spinal nerve is compound."

That "wherever we trace nerves of motion we find that, before entering the muscles, they interchange branches, and form an intricate mass of nerves, or what is termed a plexus. The plexus is intricate in proportion to the number of muscles to be supplied, and the variety of combinations into which the muscles enter."

That "taking the spinal marrow as a whole, its offices are of a double order. First, in relation to the brain; secondly, as having powers emanating from itself, or independent of the brain."[8]

That "it is not determined whether the cineritious matter visible in the section of the spinal marrow belongs to the columns which have reference to the brain, or are distinct organs and new sources of power."[9]

That "the anterior column of each lateral division of the spinal marrow is for motion; the posterior column is for sensation; and the middle one is for respiration. The two former extend up into the brain, and are dispersed or lost in it; for their functions stand related to the sensorium: but the latter stops short in the medulla oblongata, being in function independent of reason, and capable of its office independently of the brain, or when separated from it."

That "an injury to the brain, sufficient to destroy sensation and volition, leaves the spinal marrow in possession of its function, and commanding the actions of respiration."

It is interesting to see how he supplemented his anatomical knowledge by experimentation on living animals, and how repugnant any vivisection was to him on account of his sympathetic nature. Most of his experiments and demonstrations were made by his faithful assistant and brother-in-law, John Shaw:

"After delaying long on account of the unpleasant nature of the

[8] This, I think, is the first intimation we have of the function of reflex action.

[9] Note how careful he is in his assertions.

operation, I opened the spinal canal of a rabbit and cut the posterior roots of the nerves of the lower extremity; the creature still crawled, but I was deterred from repeating the operation by the protracted cruelty of the dissection. I reflected that an experiment would be satisfactory if done on an animal recently knocked down and insensible; that whilst I experimented on a living animal, there might be a trembling or action excited in the muscles by touching a sensitive nerve, which motion it would be difficult to distinguish from that produced more immediately through the influence of the motor nerves. A rabbit was struck behind the ear, so as to deprive it of sensibility by the concussion, and I then exposed the spinal marrow. On irritating the posterior roots of the nerve, I could perceive no motion consequent in any part of the muscular frame; but on irritating the anterior roots of the nerve, at each touch of the forceps there was a corresponding motion of the muscles to which the nerve was distributed. Every touch of the probe or needle on the threads of this root was attended with a muscular motion as distinct as the motion produced by touching the keys of a harpsichord. These experiments satisfied me that the different roots and different columns from whence these roots arose were devoted to distinct offices, and that these notions drawn from the anatomy were correct."

Still resting on his anatomy, he asked himself the question: If I follow the anterior column up into the brain, shall I find the nerves arising from it motor nerves? He traces the anterior column into the corpus pyramidale, and finds there the origin of the ninth nerve (the hypoglossal of our nomenclature), the motor nerve of the tongue.

"Following up the corpus pyramidale, we find issuing from it the sixth nerve, a muscular nerve of the eye. Still following up the *tractus motorius* through the *pons varolii*, we come to the roots of the third nerve, the motor nerve of the eye. *Thus all the nerves arising in this line from the crus cerebri to the cauda equina are muscular nerves.*"

To combat the prevailing opinion that ganglions were intended to cut off sensation, he cut the sensory root of the fifth pair in an ass, destroying the sensibility in all the parts supplied by the nerve. He then cut the nerve of the seventh pair without affecting the sensibility.

"By pursuing the inquiry, it was found that a ganglionic nerve is the sole organ of sensation in the head and face: ganglions were therefore no hindrance to sensation; and thus my opinion was confirmed, that the ganglionic roots of the spinal nerves were the fasces and funiculi for sensation."

Finding a portion of the fifth nerve which did not enter the ganglion, he argued, comparing the fifth pair with the spinal nerves, that this was its motor root. To confirm this he made the following experiment:

"The nerve of the fifth pair was exposed at its root in an ass, the moment the animal was killed; and on irritating the nerve, the muscles of the jaw acted, and the jaw closed with a snap. On dividing the root of the nerve in a living animal, the jaw fell relaxed."

To show his subtile analysis he asked himself the question: If the origin of the fifth nerve is distant from the termination of the column of the cord for respiration, how are the features to be moved in sympathy with the lungs and with the respiratory actions of the breast, neck and throat? And he found that this was effected through the portio dura, a nerve of very distinct origin and different course. He was thus the first to clinically differentiate the facial paralysis due to disease or injury of the portio dura. Many who came to him fearing deep brain trouble were sent away happy with his assurance of its superficial and innocent nature. There are several interesting clinical cases recorded in the appendix to "The Nervous System of the Human Body."

Next in importance to his discovery of the motor and sensory nerves is his paper on the nerves of respiration, and his conception of this function. Only a great anatomist and a genius could have taken the breadth of view and could have based it upon such accurate anatomical details. He had early taken this view in his Anatomy of Expression when he studied the facial expressions with the muscular and respiratory movements in connection with the different emotions. Under the respiratory movements he included the movements of the facial muscles in all the facial expressions, the movements of the nose, lips, soft palate, larynx, chest, diaphragm, and what we know to-day as the auxiliary muscles of labored respiration. Having located the motor nerves in the anterior column, the sensory in the posterior column, and the "nerves of respiration" in what he called the "respiratory column," he was led to give to this lateral column a function as distinctive. The mistake he made in locating the respiratory function in the lateral column of the medulla, based on the origins of the portio dura, the glossopharyngeal, the pneumogastric and the spinal accessory, making the column the distinctive one for respiration the entire length of the spinal cord, and even, in his imagination, continuing it up as high as the origin of the motor oculi, was a very natural mistake, when considered with his discovery of the anterior and posterior roots of the spinal nerves in their relations with the anterior and posterior columns. And mistaken as he was, his conception of the great function stands to-day as it was then conceived. The only mistakes he made with the cranial nerves were with the glossopharyngeal and pneumogastric which he regarded as wholly respiratory and muscular. Respiratory in a certain way they are, but he failed to recognize their sensory functions. With these exceptions, the cranial nerves, in broad outline, as he elaborated them, stand to-day."

"Sir Charles Bell's conception and classification of the cranial nerves is in wonderful accord with the most recent researches of His, based upon microscopic and embryological studies. Sir Charles saw plainly that the fifth pair was in type a spinal nerve with its motor and sensory root. A spinal nerve with its two distinct roots was the standard, the typical compound nerve, which he called "regular," in contra-distinction to those cranial nerves which apparently had but one root, motor or sensory, or which supplied special sense organs, or the organs of respiration. These he called "irregular" nerves as deviating more or less from the spinal type. Recent researches must still sanction this division into regular and irregular nerves, although the latter have been shown to be less irregular than the gross anatomy would indicate. For example, the *pars intermedia* of Wrisberg seems in all probability the afferent root of the facial, while the glosso-pharyngeal and par vagum, classed as primarily sensory, have also their efferent roots and efferent ganglia. And most interesting of all, the ganglion of Froriep, a transitory collection of nerve cells representing in a rudimentary condition the afferent

In the great intricacy of the subject it is wonderful, indeed, that he made such few mistakes. His conception of the portio dura, glossopharyngeal, pneumogastric and spinal accessory, as functionally combined, basing his conception on the fact that these four nerves came out from the same column in series, broadly speaking, holds still. Modern research has only elaborated the conception. There is something very beautiful in the way he worked out his whole idea of respiration. The movements of the facial muscles, of the wings of the nose and lips, of the soft palate, glottis, and larynx, of the chest and diaphragm, of the auxiliary muscles of labored respiration, and the muscular movements in connection with sniffing, coughing, crying, laughing and vomiting, he brought into correlation with his respiratory nerves. He called the portio dura the respiratory nerve of the face, the spinal accessory,[11] the superior respiratory nerve, and the posterior thoracic going to the serratus magnus, the external respiratory nerve. The greatness of the work can only be realized when compared with what was known in his day, or rather not known, of the physiology of the nervous system.[12]

In his paper before the Royal Society, "On the Nervous Circle which connects the Voluntary Muscles with the Brain," he showed that "Between the brain and the muscles there is a circle of nerves; one nerve conveys the influence from the brain to the muscle. Another gives the sense of the condition of the muscle to the brain." In his dissections he had traced both sensory and motor nerves to the muscles, and his intuitive genius saw the necessity of a muscular sense. "If a rope dancer measure his steps by the eye, yet on the other hand a blindman can balance his body. In standing, walking and running, every effort of the voluntary power which gives motion to the body, is directed by a sense of the condition of the muscles; and without this sense we could not regulate their actions." It took a genius to see that and make it the science of to-day, one hundred years later.

In his papers on the motions of the eye and the nerves of the orbit we see the same careful and thorough anatomist and acute observer. He was so great and far-reaching as an anatomist and so quick and subtile in his deductions of function from structure that his anatomy had become his all in all, and from anatomy to physiology was but one easy step. This faculty, combined with a tenderness of heart and sympathetic nature generally, made vivisection almost as unnecessary as it was positively loathsome to him. Had he had anæsthesia at his command he would undoubtedly have made more experiments in confirmation of his views and as a source of public demonstration in his lectures; and yet one must feel that nothing could have shaken his faith in the intuitions which came to him from his beloved anatomy. I do not know whether he has been quoted by the anti-vivisectionists of to-day, but surely the following concluding sentences from his paper on the nerves of the orbit is a remarkable statement in support of that cult:

". . . . In the animal body the parts present distinct textures, and are laid in a natural and perfect order; it is necessary only to trace the tubes, or to observe the symmetrical order of the nervous cords, that we may discover their respective uses; the motions, whether of the solid or fluid parts, are so regular and uniform, that the whole offers a subject for observation and induction. Anatomy is already looked upon with prejudice by the thoughtless and ignorant: let not its professors unneeessarily incur the censures of the humane. Experiments have never been the means of discovery; and a survey of what has been attempted of late years in physiology will prove that the opening of living animals has done more to perpetuate error than to confirm the just views taken from the study of anatomy and natural motions.

"In a foreign review of my former papers the results have been considered as a further proof in favor of experiments. They are, on the contrary, deductions from anatomy; and I have had recourse to experiments, not to form my own opinions, but to impress them upon others. It must be my apology, that my utmost efforts of persuasion were lost, while I urged my statements on the grounds of anatomy alone. I have made few experiments; they have been simple and easily performed; and I hope are decisive."

Sir Charles's vision was somewhat obscured by his own brilliancy. He failed to see that investigators of lesser powers might need the help which he could dispense with; and he also failed to see that great as his debt was to anatomy and to his own genius, experimentation was still the final crucial test. The protest against vivisection had this value, at least, that it led to a more restricted use of the privilege, limiting it to those best qualified to use it, and under certain conditions only. The advent of anæsthesia has much simplified the problem. The new science of biology, as of course every biologist knows, is largely based on intelligent experimentation. It was undoubtedly against the French school that Bell's protest

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nucleus of the hypoglossal, a typical motor nerve. So closely has nature held to the type.

Sir Charles's classification of the motor cranial nerves into motor proper and respiratory coincides with the classification of His into the motor nerves arising from the mesial area of the basal lamina of the primitive brain vesicle, and the motor nerves of the lateral area of the basal lamina, with the exception only of the motor root of the fifth pair which His includes with Sir Charles's "respiratory nerves."

[11] In this connection Sir Charles Bell quotes Lobstein, a contemporary of his, professor of anatomy at Strassburg, who, in a dissertation on the spinal accessory, finding it difficult to account for the *nervous fluid* coming by a double passage to the muscle, and unable to discover its true function, made the prediction: "*Veniet forsan tempus quo ista quæ nunc latent, dies extrahat* (sic) *et longioris ævi diligentia.*" He was unaware that already the day and the diligence of his own age had discovered the secret, or a large part of it. These Latin words he consciously or unconsciously picked out of his memory from Cicero, who first wrote them, and in an additional sentence elaborated the thought. They seemed to me an apt motto for this poper.

[12] It is strange, perhaps, in his broad conception of the function of respiration that he says nothing of the sensory side of the function, the *besoin de respirer*, especially as he saw so clearly the muscular sense with the voluntary muscles. All his thoughts and anatomical researches were directed to the motor nerves supplying the respiratory muscles. Even the glosso-pharyngeal and par vagum were motor nerves to him. His error came from the confidence he had in his "respiratory column" of the cord. If the portio dura and the spinal accessory came out from the same groove in the cord and were motor respiratory nerves, surely the two intervening nerves coming out from the same groove were also respiratory motor nerves.

was directed. His contemporary in France was Magendie, who was an ardent vivisectionist, whose work on physiology was based on experiments on living animals. What one accomplished by anatomy and pure genius, the other beat out laboriously by painful and persistent experimentation, yet missing after all the great solution of the problem.

In 1809, to show his interest in surgery, and at a time when he was still absorbed in his anatomical studies, he went down to Portsmouth to study gun-shot injuries in the wounded from the battle of Corunna. He made many fine drawings and paintings of the more interesting cases. He made at that time his well-known drawing of opisthotonos, from a case of tetanus from gun-shot injury of the skull. It is still copied in our text-books.

On June 3, 1811, he married Marion, second daughter of Charles Shaw, Esq., of Ayr. She was his brother George's sister-in-law. The marriage was a most happy one, though childless. Lady Bell survived her husband many years and reached a great age.

In 1815 he visited the field of Waterloo after the great battle and labored with the French surgeons in the hospitals at Bruxelles in caring for the wounded. In his note-books and letters he has given us some vivid descriptions of his experiences, and in the first volume of Quarterly Reports of Surgical Observations, published in 1816, has introduced some characteristic sketches made at the time.[13]

In 1816, 1817 and 1818 he published a series of Quarterly Reports of Cases of Surgery treated in the Middlesex Hospital, in the Cancer Establishment, and in private practice. In these three volumes we find many interesting clinical cases, giving us glimpses of the methods of the time. The most important feature revealed to me is the constant effort at careful diagnosis, the lesson of all lessons to be learned, the one sure sign of efficiency in our profession.

In his clinical jottings it was easier for him to make a rapid sketch than to write a description. Even while traveling and visiting picture galleries he would make rapid sketches of scenes and pictures as a sort of shorthand record to be afterwards elaborated. His brother John had the same gift and used it in the same way in his profession and while traveling.

In 1821 he published a volume of colored plates illustrating the great operations in surgery. In 1824 he published in book form his papers before the Royal Society under the title of "An Exposition of the Natural System of Nerves of the Human Body." It represents his greatest contribution to science and the real work of his life. It is most interesting reading even to-day, not only for its information, but as an inspiration to all workers in our profession.

In the same year he published "Observations on Injuries of the Spine and of the Thigh Bone," illustrated with very fine plates. It is a beautiful quarto volume of 100 pages, and the only polemical writing of Sir Charles I have come across.

[13] When Baron Larrey visited London he dined with Sir Charles Bell. Lady Bell wrote: "He was very happy, and remained till eleven o'clock looking over the sketches of the wounded at Waterloo, and even recognizing cases there in the French Hospital."

In 1822 he published a treatise on the diseases of the urethra, vesica urinaria, prostate and rectum, an elaboration of a work on the subject published in 1810, entitled, "Letters concerning the Diseases of the Urethra." He argued for deliberate and careful instrumentation of the urethra and for all cutting operations in the perineum, reiterating much that he had already set forth in his System of Surgery. He took great pains to refute John Hunter's idea of a spasmodic stricture of the urethra proper, an opinion which he thought had done much harm in the profession. Bell undoubtedly was right in his position. The followers of Hunter had overlooked strictures which required instrumentation, and had mistaken disorders of the bladder attended by spasm at the neck for urethral troubles. According to Bell, obstruction was mechanical obstruction. John Shaw, his faithful assistant in so much of his work, introduced the opinions of the German and Italian surgeons in support of Bell's position. Even in his earlier work Bell contended that the urethra was an elastic, not a muscular tube, and that any contraction in its caliber was the result of congestion, inflammation or exudation. Modern surgery bears him out in this view.

In 1826 he annotated his brother John's "Principles of Surgery," a large work for that day, in four volumes. He cut out much superfluous matter, long quotations from ancient and obscure Latin writers, condensing the work generally and adding many excellent notes of his own. In this work will be found a most interesting history of the operation of lithotomy. I should regard the chapters on hæmorrhage and aneurism as the most important, and as showing best the surgical qualities of the author and editor.

The work by which Sir Charles Bell is best known to the public in general is "The Hand: Its Mechanism and Vital Endowments as Evincing Design." It was written in 1833 as one of the Bridgewater treatises. He received £1000 for the manuscript. In all his work as an anatomist and physiologist, and especially in his lectures, he was ever eager to show design and intelligence in structure and function, and this design and intelligence meant for him the creative mind of a personal God. Throughout his entire life he showed a deep religious nature, which his studies only tended to deepen. This religious temperament was evidently the basis of those moral and emotional qualities which made his entire life and character so beautiful and so charming in every way. It is shown in his love for his family, in his quite constant cheerfulness and almost boyishness of nature, his strong sympathies, his tenderness of heart, and his love of all the simpler joys of life. It seemed quite natural, therefore, that he should have illustrated and annotated along with Lord Brougham Paley's Natural Theology, published in 1836, a type of religious work which seems now strangely old-fashioned. Still another work, very much in the same line, was his "Animal Mechanics," written for the Society for the Diffusion of Useful Knowledge. It had a large sale. In these books he showed the same care in presenting his facts and in sustaining his argument as in his purely scientific papers.

In 1829 the Royal Society of London awarded to him the

first annual medal given by George IV for discoveries in science. And about this time Magendie wrote to him from France that if he would send him any short account of his work he should have the French prize medal, very much of the same order.

When William IV ascended the throne Charles Bell received the Guelphic Order of Knighthood along with a few other distinguished men, among them Brewster and Herschel.

As a recognition from Germany, the University of Goettingen gave him the degree of Doctor of Medicine, honoris causa. As still further evidence of recognition his alma mater in 1836 offered him the chair of surgery.

He had been in London thirty-two years, during which time he had risen to great distinction as a man of science and had attained a good surgical and consulting practice, and with such men in the field as Sir Astley Cooper, Cline, Abernethy and other hardly lesser lights. This rise to distinction had been rapid. He early established his claim as a great lecturer on anatomy, built up his own private classes in anatomy and surgery, and was recognized as the authority on artistic anatomy. He founded a museum of normal and pathological anatomy, human and comparative, which was second only to John Hunter's. It was bought by the Edinburgh College of Surgeons and placed in the fine hall created for it.

His early connection with the School of Great Windmill Street, where he long lectured on anatomy, and with the Middlesex Hospital, where for twenty-four years he operated and delivered many courses of lectures on anatomy and surgery, added much to his reputation and position.

In 1828, on the founding of University College, Gower Street, he accepted a professorship and gave the opening lecture.[14] He became a member of the Royal College of Surgeons, and in 1824 accepted its professorship of anatomy and surgery.

His social qualities seemed quite equal to any position he might attain; yet his busy life did not permit much social life or great intimates. As Lady Bell put it in her reminiscences: "He was too much occupied to form intimacies." He was ever fond of music and the drama, and any notable singer or actor found him at the theater. He was a diner-out on occasions, and himself entertained some notable people.[15]

Even during his early struggling days he was cheerful, buoyant, and confident of his future. Rarely he writes his brother of any depression or sadness, or loneliness—of that sense of *magna civitas, magna solitudo*, as he wandered at times through the streets of "mighty, tumultuous London." He once expressed his feelings in a very subtile way when he wrote:

"I never thoroughly hated London while I could lose myself in it. I had a pleasure in wandering through streets I did not know; but at last it appeared to me to consist of insignificant parts almost infinitely multiplied."

There is a refreshing optimism which will not permit sadness.

"I thought that all was right in the system of the universe—that consistent with our desires and passions was the shortness of our life; and our being liable to suffering and disease—that without this we should have been inanimate, cold, and heartless creatures."

His attitude towards the profession was to be true to himself—true to his moral consciousness and convictions of the right. "Did I ever tell you," he wrote his brother, "I was offered £100 a year for the use of my name? But I thought they would dirty it, so I would not lend it. It was to stick on the first leaf of a journal." And this integrity had also with it a noble independence. In another letter he wrote his brother:

"You tell me to cultivate men; I wish you had said, to be industrious and cultivate a proud spirit of independence. You think of the men you mention as my superiors, and I think you wrong. My object in life is fulfilled as far as my years permit. ——— is only an amicable expectant, who has as yet disappointed the hopes of his friends. He has been creeping into a situation instead of proudly taking his seat. Think better of this, my dear brother, and when you are unsuccessful, or think yourself passed over, it will be a comfort to you to reflect on this as I do. The only virtues in the present state of society are industry and independence. My poverty is sometimes distressing, but only on certain occasions when my character outruns my means."

His ambition was always great, but it was of a high order and free from worldliness. Once he wrote: "I am quite clear that posthumous reputation is an absolute good."

It was his ambition to make discoveries in science and to be a great surgeon; an immense practice with the acquisition of much money he never strove after. He certainly had no time to cultivate practice in any outside way. He wrote his brother:

"You say that no man can rise into great practice without being in company, or, rather, say society. I do not agree with you. Pardon my vanity when I say that my business comes through, and will increase by different means. My patients are now of a proper class, whom I know nothing of. They come from my character, and are retained by finding relief; by being treated with attention and kindness. My means of being known are through my books and pupils. *I retain my consequence by preferring science to practice.*"

And later in life, when his practice had grown much, he wrote:

"But I think this driving after business will prove a poor business, in one sense. It is a wreck of mind. However, I am fast accomplishing that which we all wished and expected by my coming here, but I could as soon give myself an aquiline nose, as pursue practice, and run after patients, as I see some do."

And so, in 1836, after thirty-two years of London, where he had done his great scientific work, where he had built up his

[14] Finding the existing conditions not satisfactory, and at variance with his own ideas of a university, he soon resigned this position.

[15] He was on friendly and sometimes intimate terms with the best in his profession, notably, Sir Astley Cooper, Abernethy, Baillie, and Sir Joseph Banks. He could count among his friends Sydney Smith, Lord Brougham, Lord Jeffrey, Lord Cockburn, Sir Walter Scott, and the poets Campbell and Moore. He entertained Baron Larry, Baron Cuvier, and M. Roux, when they visited London. He was a welcome guest at many country homes of London and Edinburgh.

[16] Italics mine.

museum, where he had attained his surgical and consulting practice, and where he had made acquaintances and friends among the most desirable, he returned to Edinburgh, the city of his birth and of his alma mater, the home of his dearest brother, the haunt of his childhood, and associated with all he held most dear. For six years he was still to labor as professor of surgery in the University, and as a consulting surgeon. In 1837 he published his Institutes of Surgery, full of wisdom and valuable information, and in 1841 a volume of Practical Essays, two of which, on Squinting and on Purgatives, may be specially mentioned.

During the spring of 1840 he visited Italy and made careful artistic and archæological studies, much of which he embodied in a new edition of his Antomy of Expression, which he almost rewrote.

Late in life, even before he left London, he took up fishing as a pastime and became a most enthusiastic fisherman. For one of his temperament and intensity of life he had found it necessary to get away from London's din and toil, and to go out into the woods and fields and by the streams. These trips helped to satisfy his great love of nature and of the country; and much of his best writing was done under the inspiration of sky and woodland. He left in his note-book some essays on fishing which show the joy he got out of it.

He died suddenly at Hallow Park, near Worcester, while on a visit to friends, from angina pectoris, on April 29, 1842, and was buried in the adjoining churchyard.

In studying this great life, while we must admire his genius and all he accomplished, let us dwell even longer on the beauty and strength of his character, the purity of his heart, the simplicity of his whole nature. Not only do we see a genius unobstructed by any perversity of nature, but, on the contrary, a nature which his genius itself had made beautiful and radiant.

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A SPECIAL FUNCTION DISCOVERED IN A GLANDULAR STRUCTURE HITHERTO SUPPOSED TO FORM A PART OF THE PROSTATE GLAND IN RATS AND GUINEA-PIGS.

By George Walker, M. D.,
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In making a series of autopsies upon rats in which I had experimentally removed the prostate gland, I frequently observed a tough elastic coagulum filling the urethra. Search for the cause of this phenomenon disclosed the fact that it was produced by the mixing of the secretion of the seminal vesicles, with the secretion of two small glands adjacent to them.

This coagulation has been observed before and erroneously explained as caused by the mixing of the prostatic secretion with the seminal vesicle secretion. I made a number of very careful dissections of the anterior lobes of the prostate in order to obtain a pure secretion; this I mixed with the seminal vesicle secretion in small and large amounts, but in no case did I get coagulation. When, however, I took the secretion from a small glandular structure adjacent to and lying in the same fascia sheath with the vesicles, and mixed this with the vesicle secretion, coagulation took place immediately. Again, after having taken out the last-mentioned gland, if I then removed the anterior lobe of the prostate and mixed its secretion with that of the vesicle, I frequently got coagulation. This result was undoubtedly due to contamination with the secretion of the other gland, *i. e.*, the secretion had become more or less smeared on the field of operation so that when the prostate was subsequently removed some of the material came along with it.

Literature.—Leydig, in 1850 (as quoted by Rauther), described very accurately the accessory sexual glands of rodents. He affirmed that the prostate was made up of several lobes, all of which did not have an exactly similar structure. But he did not mention anything about the differences in their functions.

Leuckart, in 1853, stated that the secretion of the prostate gland of the guinea-pig coagulated that of the seminal vesicles; he believed that in this way a plug was formed in the outer portion of the vagina which prevented the escape of the semen.

Landwehr, in 1880, observed the same coagulation phenomenon in guinea-pigs, but did not mention the prostate secretion as taking any part in it. He concluded that it was brought about by a ferment in the blood present in the vagina of the guinea-pig following delivery. He does not seem to have taken note of the fact that it occurred even in the absence of blood.

Rauther, in 1903, in a very exhaustive article on the accessory genital glands of rodents and insectivora, confirms the observations of Leydig and gives some accurate drawings of the prostate and vesicles in which are shown the general shape of the different lobes and the character of the epithelium in each. He quotes Leydig as saying that the secretion from the prostate lobe lying near the vesicle is thicker and more turbid than that from the other portions. Rauther does not say anything about any difference in the functions of the lobes.

Camus and Gley, in 1897-1900, observed this phenomenon, and carrying their observations further, found it in mice, rats and other rodents. But despite the fact that their work was more thorough than any that had been done before, they concluded that coagulation was brought about by the secretion of the prostate and do not mention any special glands in the guinea-pig or rat as a causative factor. In hedge-hogs they found that a gland lying well down in the pelvis, not far from the anus, had this property, and that the prostate proper, or

what they designate as the internal prostate, did not possess it. For a further account of their observations see the following article entitled "The Nature of the Secretion of the Vesiculæ Seminales, etc."

Anatomical Description (Rat).—The prostate gland is usually but erroneously described as consisting of six lobes (Fig. 1): (a) two posterior sessile structures lying for the most part behind but extending upward on the lateral surfaces of the urethra so that in some cases they nearly encircle that canal; (b) two large anterior pear-shaped pedunculated lobes which stand well up and away from the urethra; and (c) two somewhat elongated club-shaped lobes which lie in the same sheath with the vesicles.

The glandular structure now under consideration consisting of two distinct lobes (Fig. 1), which for want of a better name we shall designate as the coagulating glands, has a different general shape and histological structure from the prostate; it gives rise to a different kind of secretion and has a totally dissimilar function. In the full-grown animal each lobe is from 14 to 18 mm. in length and from 3 to 6 mm. in breadth. It lies in the same fascia sheath with the seminal vesicle and is supplied by the same blood-vessel. The lobules are larger and more transparent than those of the prostate. It is much more villous and the musculature is much thicker. The secretion is thick and tenacious and contains minute flaky particles, while that of the prostate is thinner and more homogeneous. As shown in Fig. 2, the villi are numerous and long, the fibrous framework is compact, and the surrounding muscle, comprising a longitudinal and circular coat, firm and thick. The alveoli, in the non-distended state, present a large number of villi, three or four times as many as those in the prostate, and even when the gland is very much distended these disappear only in part, while in the prostate the inner surface becomes smooth and flattened out.

The cells, as shown in Fig. 4, are strikingly individual, and markedly different from those of the prostate; they are large and very irregularly shaped; in fact I have seen no organ in which the epithelium has such varied forms. In general they are of the cuboid type, but individually they vary greatly. Some are narrow and high, others wedge-shaped, others of the goblet type, some look like dumb-bells, while a few are almost round, with narrow projections reaching down to the basement membrane. The surface of the cellular layer is rendered uneven by clefts here and there between the cells.

The nuclei are situated in the middle or towards the periphery; in the majority of the cells they are nearer the periphery than the center and only very rarely are they found at the base; as a rule, the nuclei are large round or oval, with darkly-stained dots, interspersed among which is a faintly reticulated structure; in other cells the nucleus appears as a large, dense, black spot. In a few it is so faint that on first inspection it seems to be absent. Occasionally a cell is observed which looks as if it had a double nucleus, but this appearance is probably due to the fact that the cells are closely packed together.

The appearance of the protoplasm varies in the different cells; the border is more or less sharply marked out, but in the active stage the secretion in the lumen of the alveolus seems at certain points to be almost continuous with the cellular protoplasm. A very striking feature in the microscopic picture is the number of cells that have large vacuoles, some of which occupy half of the protoplasm. The protoplasm in other cells is light and has almost the appearance of a feathery frame-work. In the majority it is granular and fairly dense, but not so homogeneous as in the prostate; it is usually clearer near the nucleus and denser towards the periphery. Here and there are goblet-shaped masses extending down between the cells; these look like protoplasm, but they have no nucleus and do not reach the basement membrane.

The secretion of this gland, even in very small amount, produces a coagulation when mixed with the seminal vesicle secretion. For the characteristics of this fluid and the general discussion of the coagulation phenomenon the reader is referred to the following article in this number of the BULLETIN.

The two anterior lobes of the prostate gland (Fig. 1) are held in place by a fascia extending over the bladder; they have also a special fascia capsule. Each lobe communicates with the urethra by a single duct. In a well-grown animal they are about 15 mm. in length and 8 to 10 mm. in breadth. Their lobules are small and they are not so transparent as those of the coagulating gland. Figure 3 shows a cross-section of one of them. It is made up of a large number of alveoli which are held together by a rather loose connective-tissue frame-work; each of these alveoli is surrounded by a more or less complete circular and longitudinal muscular coat. In the non-distended state the lumen shows a number of villous projections, but when full of secretion these villi disappear and the surface is smoothed out.

The cells (Fig. 5) are arranged in one layer. They rest directly on a very delicate basement membrane; they are cuboidal; their periphery is in some instances smooth, in others it is broken so that it is hard to differentiate between the actual boundary of the cell and the secretion in the lumen.

The nucleus is situated near the base; it is round or oval, is moderately large, in some cells very light and in others very deeply stained.

The protoplasm varies with the stage of activity. During secretion it is very granular and studded with very minute particles; these are denser towards the periphery. Occasionally light places are seen almost like vacuoles, but these are not nearly so prominent as in the other gland.

The secretion is thin, clear or slightly cloudy and alkaline in reaction. It contains a large amount of inorganic material composed mainly of chlorides together with a considerable proteid constituent. *This secretion does not produce any coagulation when mixed with the fluid from the seminal vesicles.*

The posterior lobes, although in general of a different shape and emptied by several ducts, have a similar histological structure and their secretion is the same as that from the anterior lobes; presumably, therefore, their functions are identical.

The seminal vesicles will be described briefly in order to make clearer their relationship to the foregoing. They consist of two large alveolated sacs; each of these usually has only

one chamber, but occasionally partitions divide the vesicle into separate compartments.

The epithelium is cuboidal and is arranged in one layer; the nuclei are situated near the base; they are oval or round and stain more or less densely. The protoplasm is granular and resembles that of the prostate more than that of the coagulating gland.

The secretion is white and has the consistence of a thick cream. After being allowed to stand it becomes thicker and is like a soft gelatine. As before stated, it coagulates on being mixed with the secretion from the coagulating gland.

Anatomical Description (Guinea-pig).—The organs of the guinea-pig (Fig. 6) have a different shape from those of the rat. This difference is particularly marked in the seminal vesicles. A description of the prostate has been given by several investigators; all of the lobes are supposed to belong to the prostate gland and no author has suggested any differentiation in function.

According to my observations the prostate gland consists of two posterior sessile lobes, which correspond to those of the rat, and two rather thin anterior pear-shaped pedunculated leaf-like lobes, which are similar to but not quite so large as those of the rat. The other lobes, which have hitherto been considered as part of the prostate gland, lie near the vesiculæ seminales and correspond to what I have called the coagulating gland in the rat.

The coagulating glands (Fig. 6) are situated very close to the base of the seminal vesicles; in fact intimately hug them. This structure (Fig. 7) has a much denser muscular and fibrous framework than the prostate proper; the tubules are fewer, the lumina of the alveoli larger, and the villi much more numerous. Toward the apex of each lobe the alveoli are separate, but they converge toward the base and empty into a single duct.

The epithelium is arranged in one layer. The cells are regular, of the columnar type; their nuclei oval or rounded; they stain moderately deeply and are situated for the most part near the base of the cell. Their protoplasm is evenly granular and not at all vacuolated. These cells are somewhat different from those in the corresponding gland of the rat and are more like those of the prostate of the rat.

The secretion from this glandular structure is viscid and clear. When it is mixed, even in very small proportions, with the seminal vesicle fluid of the guinea-pig or the rat, an immediate and very pronounced coagulation occurs.

The anterior lobes of the prostate (Fig. 8, cross-section) are made up of tubules, which have the same general shape as those in the rat, but are not so numerous, are smaller and the fibrous structure holding them together is denser. The muscular arrangement is the same. In the empty state the villi are very apparent, but these become pressed out and the surface becomes smooth when the lumen is distended.

The epithelium is arranged in one layer. The cells are columnar and rather tall; their periphery is even. The nuclei are round or oval, and they are situated, particularly in the high cells, nearly in the middle. The protoplasm is evenly granular, does not show any vacuoles, in places is slightly reticulated and towards the top of the cell is more dense.

Each of these anterior lobes communicates with the urethra by a single duct.

The secretion consists of a thin turbid fluid with a slightly alkaline reaction. It does not produce any coagulation of the seminal vesicle fluid, no matter in what proportion it is mixed with it.

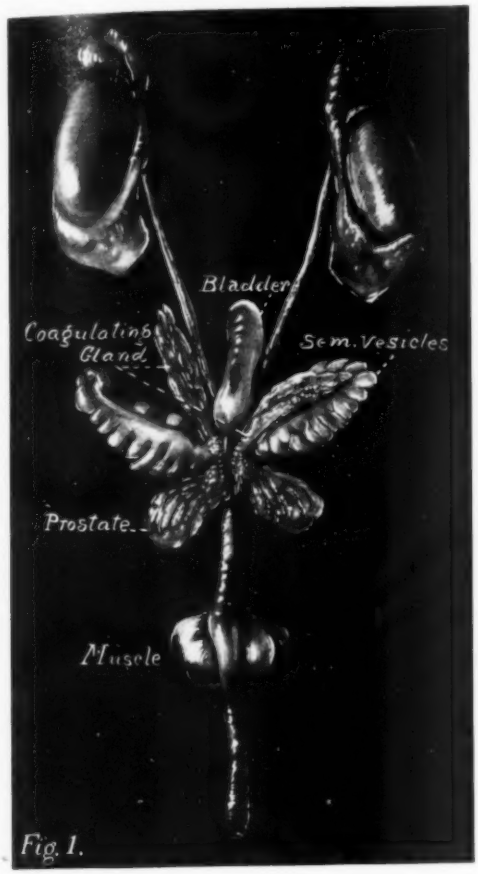
The *posterior lobes* have the same histological structure and the same secretion as are found in the anterior; they empty into the floor of the urethra through several ducts.

The seminal vesicles are free in the peritoneal cavity except for their attachment at the urethral end. They are two delicate worm-like structures about 10 cm. in length and 6 mm. in diameter at their base; they taper from the urethral to the distal end. The outside is smooth and is covered by a fascia sheath which supports the blood-vessels. Each vesicle consists of a single chamber. The inner surface, even when the lumen is distended, presents a number of very delicate and branched villi. There are two muscular coats, a circular and a longitudinal. The epithelium is one layer in thickness; the cells are slender, tall and very similar to those seen in the rat. Each vesicle empties by a single duct into the urethra.

The secretion consists of a clear, tenacious material which during life is fluid, but, within a few minutes after death, assumes the consistence of a prepared gelatine. When mixed with a small portion of its own coagulating gland secretion or with that of the rat, it is immediately coagulated.

The Relationship between the Ducts of the Prostate, Coagulating Gland and Seminal Vesicles of the Rat.—By carefully prepared serial sections I have studied the ducts leading from the various glandular structures. All of these empty into the floor of the urethra near a point corresponding to the veru montanum. The ducts from the coagulating glands pass along with those from the seminal vesicles and empty on the floor of the urethra just behind them. The seminal vesicle ducts then empty just in front of the coagulating gland ducts. The ducts from the large anterior lobes pass down and become so intimately mingled with those from the posterior lobes that it is difficult to say exactly where they terminate. I am fairly positive, however, that they empty in front of those from the coagulating glands and seminal vesicles. The ducts from the posterior lobes, eight or ten in number, have separate openings and these are scattered before and behind the openings of the seminal vesicles and the coagulating glands; for the most part they are in front. The ejaculatory ducts become blended at their mouths with the ducts from the seminal vesicles, but this does not occur until the mucosa of the urethra is reached.

The coagulating gland should not be considered a part of the prostate. From the above description it is clear that the glandular structure in guinea-pigs and rats, which I have designated as the coagulating gland, is not a portion of the prostate and should not, therefore, be so named nor considered. It has a different general shape, a different histological structure and



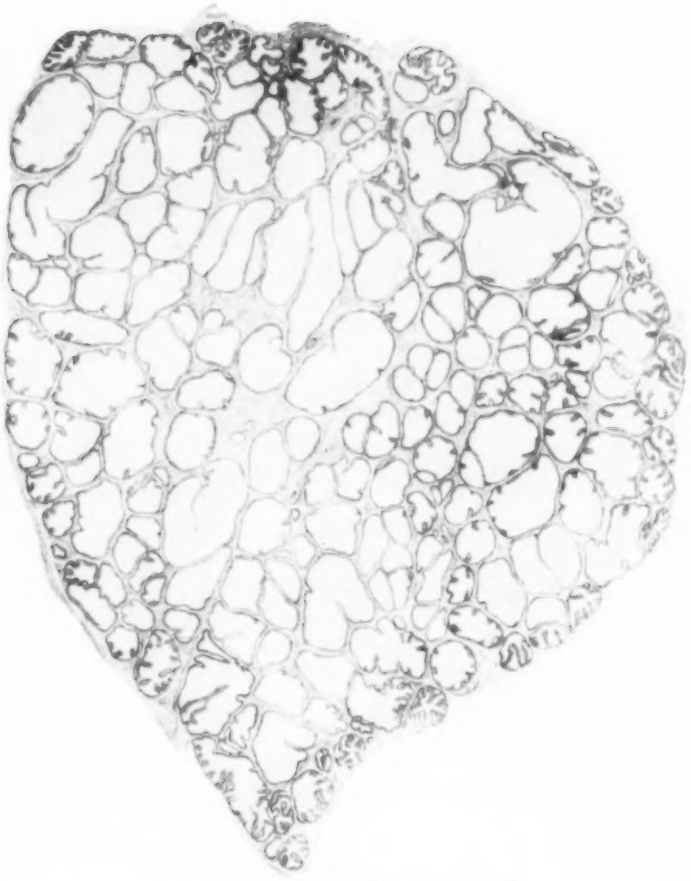


Fig. 3.—Prostate Gland, Rat. × 21¾.

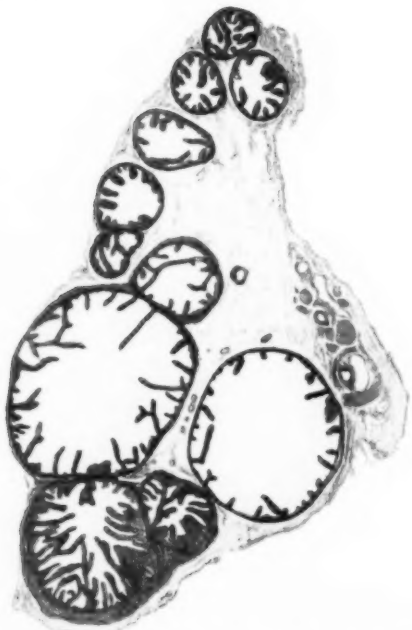


Fig. 2.—Coagulating Gland, Rat. × 19½.

Fig. 4.—Coagulating Gland, Rat. × 460.

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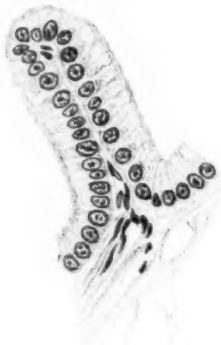

Fig. 5.—Prostate Gland, Rat. × 460.

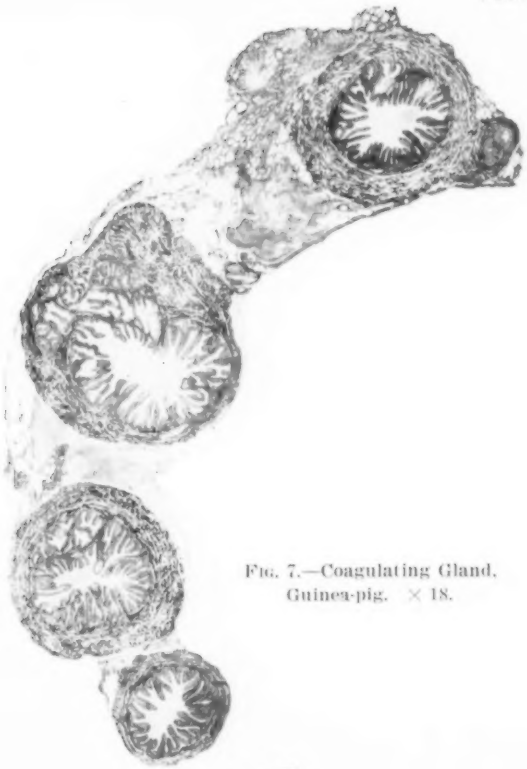

Fig. 7.—Coagulating Gland, Guinea-pig. × 18.

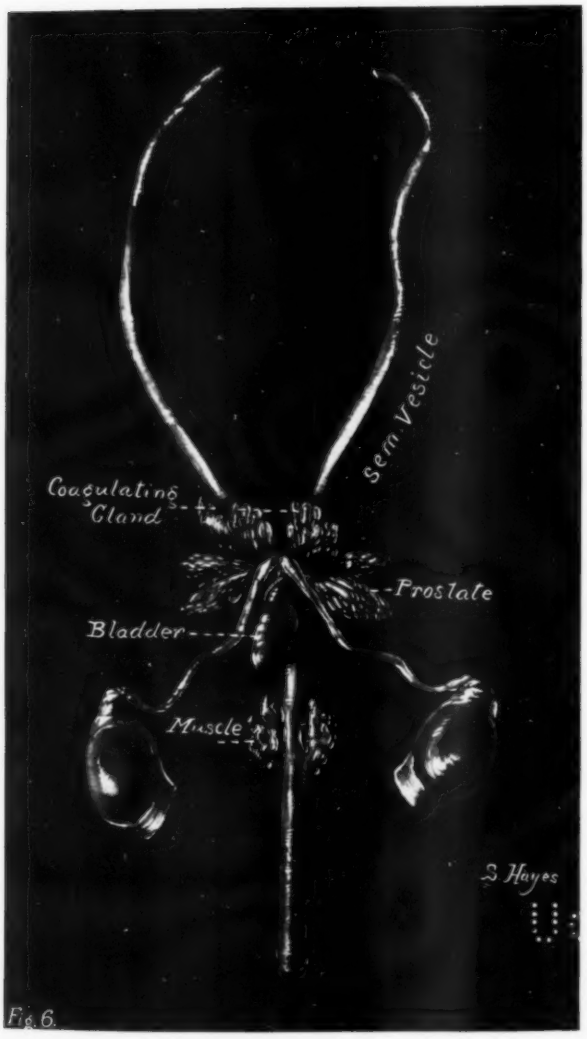

Fig. 6.

Fig. 8.—Prostate Gland, Guinea-pig. × 16½.

gives rise to a secretion which is physically and chemically unlike the prostatic fluid, and has entirely distinct functions.

The function of the prostate is probably to furnish a secretion in which the spermatozoa can move freely; as they are extruded from the ejaculatory ducts in rats, they are so closely packed together and in such a thick, tenacious material that they can have no practical motility.

The secretion of the prostate furnishes a diluent and perhaps a stimulant; in the absence of this gland its place may in part be taken by Cowper's gland and the urethral glands. The coagulating gland furnishes a secretion which coagulates the seminal vesicle secretion, and by this means a plug is formed in the outer portion of the vagina, which probably prevents the escape of the semen. This gland, therefore, furnishes a fluid which is in every way distinct from that of the prostate.

Does the coagulating gland exist in other animals? Just how extensive is the occurrence of this gland in the animal kingdom I do not know. It is present in rats, guinea-pigs, mice and probably in hedge-hogs. I have failed to find it in rabbits; it is probably not present in the carnivora, for most of them have no seminal vesicles. I have examined bullocks, but was unable to find it and the chemical examination of the seminal vesicle secretion does not indicate that it contains a substance similar to that found in rodents.

In the human subject coagulated particles in the semen suggest the presence of the gland but I have been unable to find it. The normal secretion from a human seminal vesicle is thick and sticky and resembles in physical consistency that of the rat. In the ejaculated fluid one always finds semi-solid and occasionally solid particles. This certainly suggests coagulation, for this lumpy material differs from the normal vesicle secretion and it appears, therefore, that it has been produced at the moment of ejaculation.

It is possible that the human seminal vesicle has a similar function to that of the rat; operating, however, to a much less degree and while not producing a definitely formed coagulation, the vesicle secretion, when mixed, may form a soft coagulum, the purpose of which is to adhere to the walls of the vagina and would tend to prevent the spermatozoa from escaping when the female is in the upright posture. This, of course, in so far as the human subject is concerned, is largely hypothetical, but I trust that I may be able within a short time to make the examination in a sufficiently fresh subject to determine the exact condition.

SUMMARY.

1. The glandular structure lying in the same sheath with the seminal vesicles of the rat and guinea-pig is very different histologically from the prostate and has an entirely distinct function.

2. The secretion from the above gland, which I have designated as the "coagulating gland," coagulates the seminal vesicle secretion when mixed with it.

3. The secretion from the prostate gland does not coagulate the seminal vesicle secretion.

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THE NATURE OF THE SECRETION OF THE VESICULAE SEMINALES AND OF AN ADJACENT GLANDULAR STRUCTURE IN THE RAT AND GUINEA-PIG, WITH SPECIAL REFERENCE TO THE OCCURRENCE OF HISTONE IN THE FORMER.

By GEORGE WALKER, M. D.,

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Leuckart (1853), from some observations made on guinea-pigs, concluded that when the prostatic secretion was mixed with the seminal vesicle fluid a coagulum was produced.

Landwehr (1880) observed this same coagulation, but apparently did not connect the prostate with the change. He concluded that the vesicle fluid was coagulated by a ferment of the blood which is present in the vagina just after the female has given birth to her young, the male having sexual intercourse with the female very soon after delivery. He thought that the substance in the secretion from the vesicles was akin to fibrinogen.

Camus and Gley (1897-1900) observed the same phenomenon and extended their investigations to rats, mice, hedgehogs and the myopotamus. According to these authors the secretion from the prostate gland of the rat or guinea-pig coagulates the secretion from the seminal vesicles in the respective animals and also that the secretion from the prostate of one would coagulate the vesicle secretion of the other.

They noticed that only a very small quantity of the prostatic fluid was necessary to effect this coagulation and from this fact and other experiments they concluded that the fluid contained a ferment which they called "vesiculase." This

substance is destroyed by a temperature of 100° C., but when evaporated to dryness it stands 140° C., without being damaged. In the hedge-hog the gland which secretes this fluid is situated low in the pelvis and probably corresponds to Cowper's gland. The prostate proper, according to them, in this animal does not contain a coagulating agent.

These authors did not differentiate in rats and guinea-pigs between the prostate and the peculiar gland which produces this unusual secretion; at least, in none of their articles do they mention any special organ, but speak solely of the secretion of the prostate.

My own observations have led me to conclude that:

(1) The prostatic secretion does not produce any coagulation at all when mixed with the seminal vesicle secretion, provided that care is taken to prevent contamination from a neighboring gland.

(2) The material which produces the coagulation comes from a glandular structure adjacent to the seminal vesicles.

(3) The prostate gland and the gland above mentioned are two entirely different structures with separate and distinct functions. My reasons have been given in full in the accompanying article entitled "A Special Function Discovered in a Glandular Structure," etc.

(4) The substance found in the seminal vesicle secretion most probably belongs to the group of histones.* The data upon which this conclusion is based will be set forth in the following pages.

Miescher, in 1878, separated a substance from the spermatozoa of the salmon which he called protamine. Kossel later studied this body and determined that it was the simplest protein substance.

Kossel, in 1884, isolated from the red blood cells of a goose a material which he named *histone*. Since that time he has found this same agent in the spermatozoa of various fish and in the thymus gland of the calf.

Histone, according to Kossel, has a somewhat more complicated molecule than protamine. He places it, therefore, in his protein classification next in line above protamine. These two substances have numerous properties in common.

The characteristic reactions of the histones are the following:

(1) They are not coagulated by heat unless there is present a definite quantity of salts, particularly of sodium chloride.

(2) They are precipitated by ammonia in the presence of ammonium salts and, under certain conditions, by ammonia in the absence of the salts.

(3) They are thrown down by nitric acid, the precipitate clearing up on boiling and reappearing on cooling.

(4) According to the observations of Ivor Bang they precipitate other proteins, particularly egg albumen, blood serum and casein.

(5) They are thrown out of neutral solutions by the alkaloidal reagents, sodium phosphotungstate, sodium phosphomolybdate and potassium ferrocyanide (Bang).

(6) They have a nitrogen content varying from 14 to 19 per cent.

(7) When hydrolyzed they break up into diamino-acids, notably the three hexone bases, lysin, histidin and arginin.

(8) They contain sulphur.

The protamines differ from the above in the following respects:

(1) They are not coagulated by heat.

(2) They are more strongly basic.

(3) They are precipitated by the alkaloidal reagents from an alkaline medium.

(4) They do not contain sulphur.

(5) They give a less pronounced reaction to the biuret and to the xanthoprotein reagents.

Seminal Vesicle Secretion (Rat).

The vesicle secretion is a white fluid having about the consistence of a thick cream. It is slightly alkaline, has no odor, and, after the death of the animal, becomes thicker and finally almost gelatinizes.

Relationship of the Vesicle Secretion to that of the Other Glands.—When a very small quantity of the secretion of the adjacent gland, which we shall here call the "coagulating gland" is mixed with the natural vesicle secretion, an immediate coagulation occurs. If this secretion is added to the salt solution vesicle extract, a coagulation soon takes place to such an extent that the whole fluid seems to become solid.

If the prostatic secretion is taken out with great care so as to avoid any possible contamination with that of the other gland, there is no coagulation when it is mixed with the natural vesicle secretion, nor is there any coagulation of the salt solution extract even when the prostatic secretion is added in large amount and allowed to stand for a number of hours.

Determination of Weight of Dried Substance and Ash.—The material from five rats was very carefully taken out so as to avoid contamination. This was weighed and kept in an oven for two days at a temperature of 70° C.; for two days at 80° C.; for two days at 100° C., and finally for one day at 110° C. Weighings were made at intervals and the substance was dried until the weights became constant. The material did not show any evidence of overheating. After the final weighing the dried substance was incinerated.

The weights were as follows:

Weight of material from 5 rats.....	3.203 gm.
Weight of material after drying ...	.798 gm.
Weight of material after combustion	.0114 gm.

* For those readers who have not familiarized themselves with the recent classification and nomenclature of proteins, a short synopsis is given. The following has been recently adopted by the American Physiological and Biological Chemical Societies:

Simple Proteins.	Conjugated Proteins.	Derived Proteins.
(a) Albumins.	(a) Nucleoproteins.	(a) Proteans.
(b) Globulins.	(b) Glycoproteins.	(b) Metaproteins.
(c) Glutelins.	(c) Phosphoproteins.	(c) Coagulated proteins.
(d) Alcohol-soluble proteins.	(d) Hæmoglobins.	(d) Proteoses.
(e) Albuminoids.	(e) Lecithoproteins.	(e) Peptones.
(f) Histones.		(f) Peptides.
(g) Protamines.		

Solubility.—The following agents were employed to dissolve the material: Distilled water; 0.6 per cent sodium chloride solution; 0.5 per cent hydrochloric acid solution; 0.5 per cent acetic acid solution; and 0.5 per cent sodium hydrate solution.

Distilled Water.—When the vesicle secretion was mixed with distilled water, the fluid remained cloudy and could not be filtered nor centrifuged, nor did it separate on standing. One could not, therefore, in this manner determine anything about the solubility. Accordingly a solution of the vesicle material in salt solution was dialyzed until it was salt free, or at least so nearly so that the surrounding fluid gave no reaction to nitrate of silver. The material in the dialyzer was still in solution, no precipitate having occurred, and it gave the test characteristics for the vesicle secretion. I concluded, therefore, that the material is soluble in distilled water.

A second test was made in the following manner:

The salt solution extract was precipitated with alcohol and the precipitate washed several times with dilute alcohol. It was then evaporated to dryness and taken up in distilled water. This solution was filtered and the clear filtrate gave the characteristic reactions. These two experiments prove conclusively that distilled water is a solvent in the absence of any salts.

Other Solvents.—The acetic and hydrochloric acid solutions apparently dissolve more than the salt solution. Sodium hydrate takes up larger quantities than either.

Salt Solution.—When the material was mixed with a 0.6 per cent sodium chloride solution a thick emulsion was produced. This filtered with difficulty, but on standing, or being carefully centrifuged, a clear supernatant fluid could be obtained which was found to be rich in protein. A sodium chloride solution was therefore adopted for the experimental work.

Reactions of the Salt Solution Extract.—In order to determine the amount of the solid portion of the vesicle secretion which is soluble in a 0.6 per cent solution of sodium chloride I employed the following method:

I prepared an accurate solution of sodium chloride, and with this I made a saturated solution of the vesicle substance. Five cubic centimeters of this fluid were put in a previously weighed dish and weighed. After this, it was evaporated to dryness and then kept in an oven until all the water had been driven off, after which the residue was weighed and the amount of sodium chloride calculated and subtracted. From this it was ascertained that the amount of dried vesicle secretion in the salt solution was 1.39 per cent.

The weights were as follows:

Weight of dish.....	12.4514 gm.
Dish plus saturated solution of substance in salt solution.....	17.3743 gm.
Dish plus dried substance plus dried sodium chloride	12.5500 gm.
12.5500 minus weight of dish equals	.0986 gm.
.0986 minus .03 (NaCl) equals.....	.0686 gm.
Calculating with these figures, then, the amount of dried vesicle secretion in salt solution would be	1.39%

The solution is faintly alkaline. On boiling there is a faint cloud. After the addition of a very small quantity of acetic acid, and then boiling, the fluid remains perfectly clear. With the acids—acetic, hydrochloric and sulphuric, strong and dilute—there is no precipitate. In fact, if there is any turbidity, it disappears on the addition of the acid. With the sodium hydrate solution there is a slight precipitate, which dissolves in an excess. With a 3 per cent sodium chloride solution there is a flocculent precipitate, which is not soluble in an excess. With a half-saturated ammonium sulphate solution there is a dense precipitate; when this is allowed to settle, and ammonium sulphate crystals are added to saturation, there is an additional precipitate formed, but not nearly so heavy as in the first instance.

With a half-saturated magnesium sulphate solution, there is a precipitate, but not as great as with the half-saturated ammonium sulphate solution. On saturation with magnesium sulphate there is an additional precipitation.

When a saturated solution of sodium carbonate is added in equal volume, there is produced a voluminous precipitate, which is not soluble on heating. When a saturated solution of sodium bicarbonate or the crystals are introduced, there is no precipitation, but if acetic acid is added afterwards, a voluminous precipitate is formed. With sodium citrate, sodium phosphate or sodium acetate, a precipitate occurs. With the same potassium salts, a precipitate is produced. With the ammonium salts, precipitation results. With calcium chloride and calcium acetate solutions, there is no precipitation. With magnesium chloride or magnesium acetate there is no precipitation. Mercuric chloride produces a very dense precipitate. Basic lead acetate forms a dense precipitate. Trichloracetic acid gives a heavy white precipitate, which does not change on heating. With alcohol there is a light, very voluminous white precipitate.

Characteristic Reactions.—The following reactions for the secretion from the seminal vesicles of the rat correspond identically with those for histone:

(1) With concentrated nitric acid in the cold a dense precipitate is produced; this entirely clears up on heating, so that the solution is practically clear; on cooling the precipitate reappears.

(2) When ammonium hydrate is added, there is produced a precipitate. If the ammonia is added very slowly, a precipitate is formed, which sometimes is soluble in excess, but more often not. If a quantity of ammonia—I mean by this, as much ammonia as material—is dashed in, there is formed a momentary precipitate, which entirely dissolves, leaving a clear fluid. If, on the addition of the ammonia, a very small quantity of ammonium chloride is present, there occurs a voluminous precipitate, which is not soluble in excess. If the ammonia is added, so that no precipitation is produced, and then ammonium chloride crystals are dropped in, a voluminous and permanent precipitate is formed. If ammonia is added beyond saturation to a solution of the vesicle fluid containing acetic or hydrochloric acid, a precipitate is immediately formed, which is not soluble in excess. All the ammonia precipitates

are soluble on the addition of acids in excess. The above reactions correspond to those given by Bang, and are somewhat at variance with the characteristics of histone as set forth by the American Chemical Society.

(3) Precipitation by alkaloidal reagents: With a 1 per cent solution of phosphotungstate of sodium, a decided precipitate is produced; this occurs even if the vesicle solution is distinctly alkaline.

With a saturated solution of phosphomolybdate of sodium, both in alkaline and neutral conditions, there is a marked precipitate.

With potassium ferrocyanide, 10 per cent solution, a vesicle secretion, whether neutral or alkaline, gives a distinct precipitate, which partly dissolves on excess of the reagent.

(4) When the vesicle salt solution extract is added to a 1 per cent solution of egg albumen or to blood serum, there is a voluminous precipitate.

The last two reactions, namely, the precipitation by the alkaloidal reagents in a neutral medium and the precipitation of other proteins correspond with Bang's results.

The hydrochloric, acetic and sodium hydrate solutions were each separately tested for the foregoing reactions, and found to correspond except in those particulars which would be influenced by the aforesaid chemical agents. This proved that these agents dissolved the same substance as did the salt solution.

Nitrogen Content.—Two Kjeldahl estimations were made. In the first, 0.8007 gram of the dried material was used; this yielded 15.41 per cent of nitrogen. In the second instance, 0.5912 gram yielded 15.20 per cent.

Sulphur Content.—The material was fused with metallic sodium; this mass was then dissolved in water and potassium nitroprusside solution added; a beautiful purple color was obtained, indicating the presence of sulphur.

Phosphorus Content.—The material was fused with sodium carbonate and sodium chloride. This mass was dissolved in distilled water and treated with ammonium phosphomolybdate. After 12 hours there were some very indefinite yellow crystals on the side of the tube, so tiny that they scarcely could be discerned.

Protein Reactions.—The biuret reaction was quite positive; it gave a very beautiful violet color, with no tinge of red. Millon's reagent produced a typical brown red discoloration. The xanthoprotein reaction was positive in a number of instances.

Dialysis.—With dialyzers made from collodion and proven free from holes, a number of experiments were made. In no instance did any of the material pass through.

Calcium Content.—Several qualitative tests for calcium were made. It was found in only the merest trace; certainly it did not form any appreciable part of the secretion.

Mineral Content.—The mineral substance from 3.2030 grams of the natural vesicle secretion was 0.114 gram.

Hydrolysis.—In order to determine definitely the character of a protein, hydrolysis must be resorted to. It was impossible for me to try this for the reason that as I could obtain such a very small quantity from each rat, it would have taken about a thousand full-grown male rats to supply the required material.

Reactions of the Seminal Vesicle Secretion of the Rat with Extracts of Other Organs (Rat).—The liver, spleen, kidney, lungs, brain, testes and intestines were separately ground up with salt solution. These were placed in separate tubes, allowed to stand and the clear liquid drawn off. A number of small tubes were then partially filled with the vesicle secretion in salt solution; to each of these tubes two drops of the extract from one of the organs were added. That is to say that to one tube, extract of the liver was added; to another, extract of the spleen, and so forth. There was an immediate precipitation, but in none was there any coagulation, even after 12 hours. A small quantity of the gastric juice was also added to one tube; no coagulation occurred. These experiments were done in order to determine whether there is any similar coagulating agent in any other part of the body.

What Amount of Histone is Present?—It will be noticed in all of the foregoing that I have experimented with the whole vesicle secretion. A number of attempts by means of precipitation (ammonia, alcohol) were made to isolate the histone or the allied substance in a pure form, but none of these efforts was satisfactory. I am aware that this failure opens the work to criticism, and regret that it could not be avoided. Histone is most probably present, but the proportion I am not now able to state. Later I shall discuss more fully this question.

Secretion from the Seminal Vesicle (Guinea-pig).

In the living animal the vesicle secretion is fluid; at the moment of death, or very soon after, it becomes thicker, and in a short time assumes the consistency of a soft jelly; it is homogeneous, beautifully transparent, without color and with almost no odor.

When the vesicle secretion is mixed with that of the adjacent gland an immediate coagulation occurs, as in the case of the rat. The coagulated material is tough and elastic. When the vesicle secretion is mixed with the prostate secretion, provided no contamination has occurred, there is no coagulation.

Solubility.—The same solvents which were used for the vesicle secretion of the rat were tried and were found to act in much the same manner for the guinea-pig. The actual amount dissolved was approximately the same, but an exact calculation was not made.

Distilled Water.—The same experiments by dialysis and precipitation were tried and the material was found to be soluble in distilled water.

Characteristic Reactions.—Tests with the material dissolved in 0.6 per cent salt solution gave the following results:

It has a slightly alkaline reaction.

There is not the slightest cloud on boiling, nor is any produced by the addition of acetic acid and then boiling.

Acetic, hydrochloric and sulphuric acids produce no precipitate.

On the addition of an equal volume of a saturated solution

of ammonium sulphate, there is produced a voluminous precipitate. When this is filtered and ammonium sulphate added to saturation, there is a decided cloud.

With a half-saturated solution of magnesium sulphate there is no precipitate; on addition of the salt to saturation, there is formed a moderately heavy white precipitate.

With a half-saturated sodium chloride solution there is no precipitate. On saturation there is a voluminous precipitate.

A half-saturated solution of potassium or sodium acetate produces no precipitate.

With a half-saturated sodium carbonate solution there is no precipitate.

With an equal volume of 95 per cent alcohol there is produced a fine voluminous precipitate.

With an equal volume of a 10 per cent solution of potassium ferrocyanide there is no precipitate.

With an equal volume of a 1 per cent solution of sodium phosphotungstate there is no precipitate.

With an equal volume of a saturated sodium phosphomolybdate solution there is no precipitate.

With a small or large amount of ammonium hydrate, either in the presence or absence of ammonium salts, there is no precipitate.

With a solution of egg albumen there is no cloud.

With guinea-pig or rat blood serum there is no cloud.

When the salt solution extract is acidulated with acetic acid and then sodium phosphotungstate, sodium phosphomolybdate or potassium ferrocyanide is added, an immediate and dense precipitate is formed.

When concentrated nitric acid is added there is formed a dense precipitate, which not only does not clear on heating, but seems to be increased.

From the above it will be seen that the reactions shown by the vesicle secretion of the guinea-pig in some particulars are strikingly different from those in the case of the rat, some of the characteristic ones being absent; viz.:

(1) The behavior of the fluid with nitric acid is very different.

(2) It is not precipitated by ammonia in any way.

(3) It is not precipitated from neutral or alkaline solutions by the alkaloidal reagent.

(4) It does not precipitate other albumins.

Protein Reactions.—The biuret reagent gives a very beautiful purple color, with no tinge of red.

Millon's reagent gives a well-marked and typical color reaction.

The xanthoprotein reaction is typical.

Dialysis.—The material in salt solution was tried in the dialyzer a number of times; in no instance did any pass through.

Nitrogen Content.—Three estimations were made:

No. 1, 0.6206 gram of dried material yielded 16.80 per cent.

No. 2, 0.9214 gram of dried material yielded 17.15 per cent.

No. 3, 0.7060 gram of dried material yielded 17.18 per cent.

Sulphur Content.—From the same test as was made for the rat it was found that sulphur was present.

Phosphorus Content.—The ammonium phosphomolybdate test was applied. A very faint yellow precipitate was obtained, showing the presence of phosphorus, but in very small amount.

Calcium Content.—Calcium was found in very minute quantities—one might say only a trace.

Determination of Amount of Gland Secretion Necessary to Produce Coagulation (Rat).

Experiment 1.—A series of ten very narrow tubes were prepared and into each was put an equal quantity of the vesicle secretion in salt solution. A very fine capillary tube was made and the coagulating gland secretion drawn up to a mark about one inch from the end. This amount was put into tube No. 1, containing the above-mentioned vesicle secretion; into tube No. 2 double the amount; into tube No. 3, three times the amount and so on up to No. 7. An immediate precipitation occurred in all of them, being greatest in the one which had the largest quantity. After ten minutes tubes Nos. 7 and 6 were coagulated. The coagulation time in the other tubes varied from 12 to 45 minutes. At the end of this time all of them showed about the same degree of coagulation.

Into tube No. 8, one-half as much was introduced as in tube No. 1; into No. 9, one-fourth as much; into No. 10, the least quantity which I could manipulate within the tube. No. 8 coagulated after one and one-half hours; No. 9 after about three hours; No. 10 was solid after 12 hours.

Another tube, with the same quantity of vesicle secretion, was prepared; the same capillary tube as was used above was sealed and its lower end moistened for about one inch with the coagulating gland secretion; the material in the tube was stirred well with this. No immediate effect was produced, but after 12 hours there was a complete coagulation.

Experiment 2.—Eight more tubes were selected and 20 drops of the salt solution vesicle extract were poured into each. Then, a dilution of the secretion from the coagulating gland was made with normal salt solution, representing one part of the former to 400 of the latter. One drop of this mixture was put into tube No. 1 (containing the vesicle solution), two drops into tube No. 2, three drops into tube No. 3, and so on up to eight drops in tube No. 8. The tubes were all thoroughly shaken. There was a slight haze produced, but no immediate coagulation. After 10 hours the cloudiness in tubes Nos. 4, 5, 6, 7 and 8 had increased, but the material was still entirely fluid. Supposing that no coagulation would occur, two drops more of the coagulating solution were introduced into each tube. These were observed 8 hours later; 5, 6, 7 and 8 had coagulated completely; 3 and 4 were very clouded; 1 and 2 were moderately clouded. After 24 hours Nos. 3 and 4 had coagulated; after 36 hours Nos. 1 and 2 had coagulated. In tube No. 1, which coagulated after 36 hours, the dilution represented one part of the ferment to 3063 parts of the salt solution extract. Now, if we take this solution as representing 1.39 per cent of the dried vesicle material, we have approximately one part of the glandular secretion to 21,300 parts of the seminal vesicle secretion.

Guinea-pig.—A similar experiment, but not so elaborate, was done for the guinea-pig, and it was found that an exceed-

ingly small quantity, simply a little moisture on a capillary tube, would produce coagulation. With the small amount the action was correspondingly slow.

Relation of the Phenomenon to Blood Coagulation.—Some of the coagulating gland secretion was mixed with a pure solution of fibrinogen obtained from the cat's blood. Not the slightest coagulation occurred, even after ten hours. A solution containing fibrin ferment from the cat's blood was mixed with the vesicle secretion, but no coagulation occurred, even after the lapse of several hours. Fibrinogen solution was prepared from the rat's blood, and the coagulating gland secretion added; no coagulation was produced.

The blood serum of the rat a number of times was added to the vesicle secretion without the slightest effect. If, however, after the coagulating gland had been removed, blood serum, or even a blood smear, was taken from the pelvis, and mixed with the vesicle secretion, a coagulation was produced in a very short while. This test I repeated often enough and under sufficiently varied conditions to prove conclusively that this coagulation was produced by the coagulating gland secretion which had become mixed with the blood in the pelvis. If, in the same animal, I opened the chest and took the blood from that cavity, care being taken not to use the same instruments, there was never the slightest coagulation.

The Effects of Sodium Oxalate and Sodium Citrate.—One part of a 1 per cent sodium oxalate solution was mixed with nine parts of the salt solution of the vesicle material; to this was added the usual amount of coagulating gland secretion; rapid and complete coagulation occurred. One part of a 2 per cent sodium citrate solution was added to an equal volume of the vesicle solution; then the coagulating gland secretion was mixed in; coagulation occurred as usual.

From these two experiments it is seen that the two agents which prevent the coagulation of blood have no retarding influence on the vesicle phenomenon.

The Effect of Other Agents.—One seminal vesicle was taken out, ligated at both ends and placed in a tube, which was kept in boiling water for half an hour. Upon examination the secretion appeared somewhat thinner than before, but there was no hardening. A small quantity of the coagulating gland secretion was added; coagulation occurred precisely as in the fresh material.

The vesicle salt solution was precipitated with alcohol; this precipitate was washed several times with dilute alcohol and evaporated to dryness. The material was then taken up with salt solution and the coagulating secretion of the rat was added. There was some immediate coagulation; this increased after several hours, and finally about one-half of the material had coagulated. In other words, the coagulation compared favorably with that of the fresh material, but was not quite so extensive.

This reaction was tried a second time, a precipitate, which had been standing in alcohol for two weeks, being employed. Immediate coagulation occurred and in a short time the whole became entirely solid, the process resembling in every respect the ordinary phenomenon.

Characteristics of the Secretion of the Coagulating Gland.

The secretion is thick, rather tenacious, distinctly cloudy and has fine particles suspended in it; it is slightly alkaline and has a faint animal odor.

On standing in a small tube for about two hours, a white, rather granular material settles to the bottom, leaving a clear supernatant liquid. When mixed with salt solution, a slight precipitate is produced; this mixture becomes clear on standing, and the clear portion is very active in producing coagulation.

Heating the secretion up to 60° C. produces a slight coagulation, but does not affect the active agent; heating to 70° C. produces more coagulation, but the principle is still active; heating to 75° C. seems to coagulate the whole material, but if this is broken up and added to the vesicle secretion, coagulation occurs; heating to 80° C. destroys the activity entirely.

When alcohol is added to a salt solution extract of the coagulating gland secretion, a precipitate is formed. If this precipitate is washed several times with dilute alcohol, then evaporated to dryness, the residue being taken up in salt solution, and mixed with the vesicle material, coagulation occurs, but it is slower than with the fresh material.

Boiling.—The secretion, in a small glass tube, was placed in boiling water for 20 minutes; it was then taken out, thoroughly broken up, and mixed with a small quantity of trypsin. This was kept at 37.5° C. for eight hours, after which it was tested with the vesicle fluid and found to have lost its coagulating property. This experiment was made on the supposition that possibly the ferment (?) might be caught in the coagulum produced by heat, and that it could be liberated by dissolving the coagulated material.

Regaining the Active Principle.—Some of the vesicle secretion which had been coagulated was crushed into small particles and washed a number of times with distilled water; salt solution was then added and the mixture allowed to stand for one hour. The supernatant liquid was found to produce coagulation, thus showing that the ferment (?) could be regained from the coagulum.

Precipitation Reactions.—The salt solution extract with a half-saturated ammonium sulphate solution produces complete precipitation. A half-saturated sodium chloride solution produces no precipitate; a half-saturated magnesium sulphate solution causes distinct precipitation. Phosphotungstate of soda and potassium ferrocyanide produce no precipitate, unless the solution is acid. Alcohol, 95 per cent, in equal volume, throws down a voluminous precipitate. Ammonium hydrate does not produce any precipitate.

Characteristics of the Prostatic Secretion.

The prostatic fluid from the rat is thin; it varies in appearance, sometimes being almost clear, but in most instances it is turbid; it has an alkaline reaction and a distinctive odor. When allowed to stand, a very fine granular material settles to the bottom.

If the prostate gland is taken out and the secretion obtained

from it after the coagulating gland has been removed, no special care having been taken to prevent contamination, it will be found that on mixing the prostatic secretion and the vesicle secretion a slight coagulation occurs; if, however, the coagulating gland is not touched and the prostate very carefully removed and the secretion obtained pure, no coagulation can be effected by it. I have tested this still further by adding large quantities of the prostatic secretion to the vesicle secretion and allowing the mixture to stand for a number of hours —8, 12, 24—there was not the slightest coagulation. I am convinced that the coagulating effect of the prostatic fluid as obtained by Camus and Gley and by Leuckart was due to contamination by the secretion of the adjacent coagulating gland.

Precipitation Reactions.—On heating, the prostatic fluid shows a large amount of protein material. With a half-saturated solution of ammonium sulphate, there is no change; with a saturated solution, there is a light flocculent precipitate. With a half- or a full-saturated solution of magnesium sulphate, there is no change. With dilute acetic acid, a slight precipitate is formed, which dissolves in excess. With alcohol, there is a heavy precipitate, which dissolves in dilute acid. The secretion dissolved in distilled water gives a very decided reaction for chlorides.

The Relationship between the Accessory Sexual Glands of the Rat and Guinea-pig.

The coagulating gland secretion of the guinea-pig was mixed with the vesicle secretion of the rat and an immediate and complete coagulation occurred.

The coagulating gland secretion of the rat was mixed with the seminal vesicle secretion of the guinea-pig; the coagulation was slow, not being complete under about eight hours.

A mixture of the seminal vesicle secretion of the guinea-pig in salt solution was made with that of the rat in salt solution; there was a decided precipitate, which dissolved somewhat on standing, and after about four hours had nearly disappeared. To this mixture the coagulating gland secretion of the rat was added; coagulation occurred promptly.

Further Considerations on the Nature of the Seminal Vesicle Secretion.

The question as to whether the vesicle secretion of the rat consists of only one substance, or whether it is a mixture, I am not at present able to answer. Reasoning from analogy it is certainly very probable that it is a mixture, but the following indications favor the view that it is largely composed of one substance:

If a large enough quantity of salt solution is used, all the material goes into solution. If this solution is slightly acidulated and boiled, there is no coagulation. This test of itself shows that the higher proteins are not present. When precipitated by nitric acid in the cold, and then heated, the precipitate redissolves and the solution becomes clear; this excludes some other proteins. And lastly, ammonia seems to give a quantitative precipitate; about this, however, I am not sure. As previously stated, I have tried by precipitation methods to settle the question, but I have not been able to do so satisfactorily. The above, then, are not cited to prove definitely anything, but are simply given as indications.

Histone Content.—At the outset I stated that the seminal vesicle secretion probably contains histone. My reasons for this view are as follows:

(1) The solution is only slightly clouded by heat. This reaction at once indicates that a number of other proteins are not present.

(2) It is precipitated by ammonia. None of the serum albumins, globulins, or albumoses is precipitated by this reagent.

(3) It is precipitated in a neutral medium by the alkaloidal reagents.

(4) Its reaction with nitric acid.

(5) It precipitates other proteins.

(6) It contains a relatively high nitrogen content.

I feel that the above reactions, all of which I have obtained in the vesicle material from the rat are certainly sufficient to indicate the presence of histone. It remains, however, to differentiate the histone from the substances just below it—the protamines.

The protamines also are not coagulated by heat. They also precipitate other proteins. They differ, however, in being thrown down by the alkaloidal reagents in an alkaline, but not in a neutral medium. They are not precipitated by ammonia. They have a much higher nitrogen content, and they do not contain sulphur. The first three characteristics are found in the vesicle secretion, but the last three are absent. It appears probable, therefore, that we are not dealing with a protamine.

It remains now to discuss the secretion from the seminal vesicles of the guinea-pig. This is extremely interesting from the fact that it has a number of properties of the histone and a number of those of the higher proteins.

(1) It corresponds in general physical and coagulation characteristics to that of the rat; it is soluble in the same fluid; it is not affected by heat; it is coagulated by the glandular secretion of the rat; it has a high nitrogen content; it has the same color protein reactions as that of the rat. All of these characteristics lend proof to the assumption that it has a similar content and probably contains histone, but on the other hand a number of striking characteristics of histone are absent, viz.: it is not precipitated by ammonia nor by alkaloidal reagents in neutral media; it does not coagulate other albumins and does not have the usual reactions with nitric acid. The absence of all of these tends to place it among the higher groups. In order to elucidate this point more fully it will be necessary to determine the hydrolytic products. This work I shall soon take up.

Does the Coagulating Gland Secretion Contain a Ferment?

The question of interest is whether this secretion acts by virtue of a contained ferment, or whether the reaction represents only a chemical or physical chemical phenomenon. At first I thought that I had to deal with a simple precipitation. Continued experimentation, however, has led me to believe

that the change is caused by a ferment: (1) Because there is such a very great disproportion between the two fluids, 1 to about 21,000; (2) When a minute quantity is added, no change is seen for several hours, and it is only after the lapse of from 18 to 30 hours that coagulation occurs; (3) The amount of ultimate coagulation is apparently the same for a fairly large quantity or for only a trace.

The Effect of the Various Secretions on the Motility of the Spermatozoa.

A very curious phenomenon was seen when I attempted to mix the seminal vesicle secretion solution with the material pressed from the vas of the rat. The spermatozoa became immediately clumped and it was found impossible to produce any homogeneous mixture. On microscopic examination the organisms were seen to be thrown in masses; they appeared as if they had been caught by something and for the most part they were without any motion. At the margins of the clumps a few were moving slightly, but they were held fast. What is still more curious, is that when the spermatozoa of the guinea-pig are mixed with the seminal vesicle secretion of the rat, a perfectly homogeneous mixture occurs and the organisms are actively motile. When the spermatozoa of the rat are mixed with the seminal vesicle secretion of the guinea-pig there is produced a uniform mixture and the organisms move actively. This is a very interesting observation and the cause for it should be more thoroughly studied.

The spermatozoa of the rat with its own coagulating gland secretion are motile and remain so for $2\frac{3}{4}$ hours.

The spermatozoa of the rat in its own prostate gland secretion are beautifully motile, and I have observed the continuance of this motility for eight hours.

The spermatozoa of the guinea-pig are actively motile in the coagulating gland secretion of the guinea-pig.

The spermatozoa of the guinea-pig are actively motile in its own prostatic secretion.

Summary.

1. The secretion of the prostate gland proper and that of a glandular structure adjacent to the seminal vesicles are radically different in physical and chemical characteristics.

2. In neither the rat nor guinea-pig does the secretion of the prostate gland coagulate the secretion of the seminal vesicles.

3. In both the rat and guinea-pig the secretion of the glandular structure adjacent to the seminal vesicles, which I have designated as the "coagulating gland," coagulates the secretion of the seminal vesicles.

4. This coagulation is produced by a very minute quantity of the secretion; one part of the secretion to about 21,000 parts of the seminal vesicle secretion is sufficient to produce the reaction. The phenomenon seems to be entirely different from blood coagulation.

5. The active principle in the secretion of the coagulating gland presumably belongs to the class of ferments.

6. The seminal vesicle secretion of the rat probably contains histone.

7. In the seminal vesicle secretion of the guinea-pig there is a substance which corresponds in part to histone and in part to the higher proteins.

8. The spermatozoa of the rat are immediately clumped when mixed with the seminal vesicle secretion of the same animal. This phenomenon does not occur in the guinea-pig, neither does the seminal vesicle secretion of the rat injure the spermatozoa of the guinea-pig; on the contrary they move actively in it.

It gives me pleasure to thank Drs. Howell and Abel for suggestions made in the course of this work, and also to express my appreciation to Dr. George Menge of the Government Hygienic Laboratory.

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PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS MEDICAL SOCIETY.

February 7, 1910.

Dr. Louis Hamman in the chair.

I. Heart Block: Report of Two Cases of Adams Stokes Disease.

Dr. W. S. Thayer and Dr. F. W. Peabody.

Dr. Thayer reported two cases of Adams Stokes Disease (Heart Block) in patients whom he had under observation.

The first case was that of a white man, aged 53 years, of excellent family and personal history. Following a morning of violent exercise the patient had an attack of dizziness, and later was taken with general convulsive seizures. When seen by a physician, his pulse was markedly slow, 6-8 beats per minute, and very irregular; breathing was labored. The patient rapidly recovered from this attack and felt perfectly well. One week later, however, a second attack occurred, and when seen by Dr. Thayer the patient was quite pale, breathing very irregular and almost pulseless. After a few convulsive seizures there was a general flushing of the skin, and the radial pulse returned. The patient was brought to the hospital and cardiographic records made by Dr. Peabody clearly showed a marked disproportion in the rates of contraction of the auricles

and ventricles. The auricular rate was 120 per minute, and the ventricular 30 per minute. The patient made a complete recovery.

The second case was that of a colored man, over eighty years of age, who for some time previous to his admission into the hospital complained of "spells of shortness of breath." For long periods of time, the heart was regular in rhythm, but at times numerous "dropped beats" were to be noted at the wrist. This condition could be brought on by applying digital pressure over the vagus nerve in the neck, when the ventricular pulsations could be affected, and the pulse rate decreased and made markedly irregular. Carefully made cardiograms showed a slight lengthening of the auricular intervals without any apparent delay in the conduction time. This patient left the hospital and has since been lost track of.

II. An Experimental and Clinical Study of the Functional Efficiency of the Kidney by Means of Phenolsulphonaphthalein. DR. L. G. ROWNTREE AND DR. J. T. GERAGHTY.

The first part of Dr. Rowntree's paper dealt with the history of the various attempts made to estimate the functional efficiency of the kidney by means of substances taken by mouth or subcutaneously. The time of the appearance of these substances in the urine was taken as a rough estimate of the ability of the kidney to excrete them. Among the substances proposed are methylene blue, indigo carmine, rosanine and phloridizin. Unfortunately the results of the use of these drugs are most disappointing, and few conclusions can be drawn from them. The essentials for a satisfactory drug for this test, is that it shall be one that is practically all excreted by the kidney, that it shall have no toxic effect and that the time of excretion be as short as possible.

In the use of a new phenolphthalein derivative, phenolsulphonaphthalein, it is believed that all these essentials are present.

Only a small amount of this drug is necessary and it apparently undergoes no chemical change in the body, as from sixty to eighty-five per cent is recovered in from two to four hours after its administration. The detection of the drug in the urine is quite easy, the addition of a few drops of alkali to the urine in the presence of the drug will give a definite color reaction. Phenolsulphonaphthalein differs from all other phthaleins in that none of the drug is secreted by the bowel, practically all being excreted by the kidney.

Dr. Geraghty reviewed the results of the use of this new drug in a large number of cases of suspected renal functional insufficiency and the results are most gratifying. Further report will be made at the completion of their experiments.

February 21, 1910.

Meeting of the Johns Hopkins Medical Society. Dr. Louis Hamman in the chair.

I. Recent Advances in our Knowledge of the Causation of Tropical Diseases. DR. J. L. TODD, McGill University, Montreal, Canada.

In a masterly review of the voluminous literature on tropical diseases, Dr. Todd outlined the most conspicuous advances in the study of these diseases. He said that the English and French governments in their efforts at colonization of the tropics have found that the conquest of these countries depends upon the conquest of the tropical diseases. Institutional work, including both laboratory and field study along these lines, with the support of the home government, is imperative.

The immense bibliography of the "sleeping sickness" disease, permits of the ascertaining of the weak points by which the disease can be combated. In the study of this disease, attention has been directed along three channels; first, as to the habits of the *glossina palpalis* or tsetse fly, through whose bite, the disease is given to man; second, as to the treatment of the disease itself; third, as to methods of early diagnosis of the disease. Among the most interesting facts regarding the tsetse fly, he says that the fly may still be able to transmit the disease seventy-five days after having bitten an infected individual. That the ordinary trypanosomes may undergo changes in the fly resembling those changes which occur when the rat serves as a host for the parasite.

Both arsenic and antimony have trypanosomicidal properties, and these two drugs are more effective when given together.

A curious fact observed by the natives is that whenever any of their number presents an enlargement of the cervical glands, that individual is most likely to be infected with the trypanosomes. Examination at autopsy has proven the truth of this belief, both for animals and for man.

Dr. Todd's paper was well illustrated by means of microscopic preparations, charts and living hosts of the trypanosomes.

DISCUSSION.

PROF. J. J. ABEL.—While Dr. Todd has given you a most interesting outline of the recent investigations in tropical diseases, he has modestly failed to mention his own connection with the many advances made in combating these diseases.

At great personal risk both Dutton and Todd have accomplished many important pieces of work both in the field and in the laboratory. They have laid great stress on the gland palpation and even gland puncture in the diagnosis of this disease. My own particular interest in the subject has been entirely in the therapeutic side, and for some time I have been experimenting with various synthesized products of arsenic and antimony as to their trypanosomicidal properties.

While it is true that by means of these two drugs the blood of small animals, such as the rat, can be cleared of the trypanosomes, the same does not seem to hold true for larger animals. The question of the size of the dose is an exceedingly difficult one to ascertain.

II. Clinical Observations upon Intestinal Putrefaction; with Remarks upon Harmful Effects of Purgatives. DR. D. L. EDSALL, University of Pennsylvania.

Dr. Edsall insists that it is the duty of the practitioner as well as the consultant, not only to examine the rectum, but to examine the fæces. He believes that in a great number of

cases showing "neurasthenic symptoms," that these symptoms may be due to chronic intestinal putrefaction. Two types of changes may be recognized; the fermentative, due to the ingestion of an excess of carbohydrates, in which the symptoms are myasthenic in nature, and the putrefactive, due to an excess of proteids, in which headaches are the main cause for complaint. The latter cases, showing putrefactive changes, seem to be much easier to handle.

In the routine examination of the fæces Dr. Edsall does not resort to the use of a test meal, but prefers to draw conclusions from the study of the stool after the patient has ingested his normal or accustomed meal.

Attention must be paid to the fat and carbohydrate disturbance and the fæces should be allowed to stand for varying periods of time, at room temperature to determine the rapidity of fermentative and putrefactive changes.

Following the habitual use of purgatives, there is evidence of marked irritation of the gastro-intestinal tract, and Dr. Edsall believes that many of the purgatives themselves may cause the very symptoms for which they are given. The field for the use of mild purgatives has become an extremely limited one.

Discussion.

Dr. J. H. M. Knox.—Dr. Knox discussed the occurrence of intestinal, putrefactive and fermentative changes in children.

The control of a healthy intestinal condition in children necessarily depends upon the choice of a suitable diet. He cited several cases of successful "lactic acid therapy" in children showing marked restlessness and sleeplessness. Here the intestinal flora was changed through the administration of the Bulgarian strain of the lactic acid bacillus.

February 28, 1910.

Meeting of The Laennec Society for the Study of Tuberculosis. Dr. Henry Barton Jacobs in the chair.

I. Exhibition of Cases: (a) Pneumothorax. (b) Multiple Progressive Serositis. Dr. Louis Hamman.

The first case exhibited was that of a young white man, aged 20 years, who came to the Phipps Dispensary on November 2, 1909, complaining of discomfort in the right side of his chest. Examination at that time was negative except for a slight prominence of the right clavicle and a diminished movement of the right side of the chest and a few scattered crackles on deep inspiration. Two weeks later, November 15, the patient was seized with a sharp pain in the right side of the chest and a sense of suffocation.

Examination revealed no movement of the diaphragm on the right side and an almost total absence of the breath sounds. A diagnosis of pneumothorax was made. A radiograph of the chest taken at that time confirmed this diagnosis. The patient was kept under observation and at the end of the first week little change was noted in the physical signs; two weeks later slight movement of the diaphragm could be detected on the left side.

At the end of the third week, the lung on the affected side began to expand. The striking features of this case were the comparative mildness of the symptoms and the slightness of the physical signs. It is difficult to offer an explanation of the etiology of this condition. The rupture of small emphysematous blebs on the surface of the lung permit air to gain entrance into the pleural sac, and formation of a pneumothorax. The healing of the bleb and reabsorption of the air permits the lung to expand.

It is interesting that this case failed to react to repeated tuberculin test.

The second case was that of a white man, aged 25 years, who for several months complained of "fever and chills." During his stay in one of the city hospitals he was treated for malaria and typhoid fever. On admission to the hospital he developed a well marked hydrothorax, which persisted and necessitated tapping ten to twelve times.

On examination, he showed a most remarkable cyanosis of the face, neck and upper portion of the chest; with engorgement of the superficial veins. An extremely coarse pleural friction rub was noted over the left front of the chest, but there were no signs of intra-pulmonary trouble. The heart sounds were feeble; there was no marked enlargement on percussion, although the radiograph showed slight enlargement of the right side of the heart.

The abdomen was distended; there was slight movable dulness, and a huge liver, which produced a prominence both in the mid line and in the right upper quadrant; the spleen could just be palpated. The case was regarded as one of multiple progressive serositis. This patient gave a marked reaction to tuberculin and before the period of injections for treatment showed at times a marked sub-normal temperature reaching as low as 94° on several occasions.

Dr. G. H. Whipple exhibited a number of pathological specimens illustrating the different phases of serositis and including a typical "iced liver" with its thick glistening capsule.

II. The Value of X-rays Examination in the Diagnosis of Pulmonary Diseases. Dr. Charles L. Minor.

In a most interesting paper Dr. Minor outlined the use of the x-ray examination as an aid to the diagnosis of pulmonary diseases. He emphasized the great importance of a thorough auscultation and percussion of the chest before fluoroscopy. His x-ray findings are only confirmatory in character and corroborate the physical signs. In a few cases, deep seated foci are revealed by the x-ray and early enlargements of the mediastinal glands are made out which would escape detection in any other way. As claimed by Williams, the slightest limitation of movement of the lungs is often made out and antedating any possible change in the physical signs. He finds fluoroscopy of great service in the detection of early apical lesions only when they are accompanied by physical signs, enlarged glands, thickened pleura and intra-lobar empyema.

March 7, 1910.

Meeting of Johns Hopkins Medical Society. Dr. Louis Hamman presiding.

I. Anaphylaxis and its Relation to Clinical Medicine. DR. JOHN F. ANDERSON, Washington, D. C.

The earliest experimental work upon the subject was that by Richet, working with actinia poison in dogs. Richet coined the word "anaphylaxis" from two Greek words *ανα* against, and *φυλάς* guard, or *φυλαξις* protection. He considered the condition an opposite one to that of prophylaxis; but we now know that the phenomenon, instead of being a disadvantage is probably an important step in the protection of the organism against a certain large class of infections.

The condition of anaphylaxis may be transmitted from the mother or may be acquired, and it may be brought about by the introduction of any strange proteid into the body. A well known clinical instance of anaphylaxis is that induced in an individual by a second vaccination. In the reaction to a primary vaccination the incubation period is about four days; i. e., in about four days the local symptoms at the point of vaccination appear or become distinctive and there is more or less constitutional disturbance. In a secondary vaccination, or a vaccination following a successful vaccination after some months, the period of incubation is much shortened and the clinical reaction very much lessened. In other words, the power to react has been so changed that, instead of an incubation period of four days, we have an incubation period of 24 to 36 hours. This acquired power of immediate response is an evidence that protective bodies have been formed within the organism; but there is no absolute immunity in this class of infections, though, on account of the power of immediate reaction the individual is protected.

Other well known clinical instances of anaphylaxis are the tuberculin and mallein reactions in tuberculosis and glanders. Neither of these bacterial products is harmful in moderate amounts to a healthy individual, but a person suffering from tuberculosis or glanders will respond to a very small amount of tuberculin or mallein respectively.

It has been known since the sixteenth century that the whole blood of certain animals is poisonous when transfused or injected into man. Many workers have found that the blood serum of an animal of one series is frequently poisonous when injected into an animal of another species, but that the serum of the horse, and the donkey to a large extent, lacks such poisonous properties. Large amounts of horse serum may be injected into man, the rabbit, the guinea-pig and other animals without causing very unpleasant results except possibly a slight reaction at the site of inoculation. In a certain proportion of cases, however, the injection of horse serum into man is followed by the syndrome described and named by von Pirquet as the "serum disease." In a very small percentage of cases the injection of horse serum into man has been followed by sudden death.

Horse serum, when injected into guinea-pigs, is a comparatively bland and innocuous substance, but these animals may be rendered so sensitive that a second injection of horse serum may produce death or at least very severe symptoms.

The first injection of the foreign protein has so changed the mechanism of the animal's organism as to render it very susceptible to the second injection. A certain time must elapse between the first and the second injection in order that this hypersusceptibility may be manifested. This time varies from 5 to 12 days and is in close accord with the period of incubation of the "serum disease" which von Pirquet places at 8 to 13 days.

As the first experimental work with anaphylaxis was done with horse serum, it was thought that diphtheria antitoxin had some part in this toxic action of the serum; but as it was soon found that the phenomenon could be induced by any protein such as those which have just been named, it was seen that diphtheria antitoxin had absolutely no part in the production of the phenomenon.

The toxic action following the injection of the serum is due to a protein in the horse serum and is entirely independent of the antitoxic properties of the serum. It would be exceedingly unfortunate if the studies upon anaphylaxis should in any way prevent the usage of diphtheria antitoxin or any other therapeutic serum when it is indicated.

The symptoms produced by the injection of horse serum into a susceptible guinea-pig are exceedingly characteristic. They are apparently the same where the animal be given the injection subcutaneously, intravenously, intraperitoneally or into the brain. When injected into the brain the symptoms appear very much more quickly and frequently with explosive violence in some instances the animals dying within three minutes after the injection.

At least a certain time must elapse between the first and the second injection of the protein before the anaphylaxis is manifest. This time or period of incubation is from 7 to 12 days, which is about the same as for the serum disease in man and is very similar to the period of incubation of a number of the infectious diseases. The optimum period or interval for the development of anaphylaxis is after three weeks.

Rosenau and Anderson believe that the portion of the protein which sentitizes the guinea-pig is the same as that which later poisons it and Wells has brought forward experimental data to show the two are at least in the same protein molecule or are two separate portions of the same molecule. The effect of heat in modifying or destroying the anaphylactic properties of proteins depends upon its effects in rendering the proteins insoluble rather than the production of chemical changes in the proteins.

Various procedures, such as the administration of atropine, injections of chloralhydrate plus urethane and adrenalin, pure oxygen and production of ether or alcohol, narcosis, all seem to exert favorable influence upon the outcome of anaphylaxis when given a short time previous to the intoxicating injection.

An interesting fact in connection with the specificity of the reaction, is that guinea-pigs may be sensitized with three proteins at the same time, and that the animal differentiates the anaphylactic-producing substances in a separate and distinct

manner and is found to be susceptible to a second injection of each one of the three substances in the same way that an animal is susceptible to three separate infectious diseases. Guinea-pigs may readily be sensitized by feeding them a protein for several days and when tested for their susceptibility after 14 days by an injection of the protein they are found to be sensitive.

The experiments upon the transmission of anaphylaxis by the female to her young are of very great interest in relation to the question of an inherited tendency to tuberculosis in children born of a tuberculous mother. It is generally accepted, Dr. Anderson believes, that the children of a tuberculous mother, instead of having an immunity to tuberculosis, on the other hand, are more susceptible. Only very rarely is the child born with the seeds of the disease in its system, but that there is transmitted from the mother to her offspring a tendency to the disease.

Man may be sensitized in the same way as has been shown to be in the case with guinea-pigs and von Pirquet and Shick in their work upon the serum disease found that when the second injection was given, after an interval of 14 days to four months, they obtained what they termed their "immediate" reaction in which the symptoms of the serum disease appeared at once or within 24 hours; but that when the interval was more than four months they obtained little or no immediate reaction, but what they termed the "accelerated" reaction, in which the symptoms of the serum disease appeared on 5th to 8th days.

The unfortunate accidents, such as collapse and sudden death, following serum injections depends more upon individual sensitization than upon the so-called toxicity of the serum used. It has been found that serum which has not produced untoward symptoms when injected into man is fully as toxic for sensitive guinea-pigs as serum, the use of which has been followed by serious symptoms or even sudden death when injected into man. It is a most interesting fact, that many of the cases of sudden death following the first injection of serum in man have been in asthmatics or in persons who have an idiosyncracy to horses. That is, there are certain individuals who show peculiar symptoms resembling hay fever or asthma, when in the vicinity of horses or horse stables and these individuals are the ones so extremely susceptible to the first injection of serum. The knowledge of the fact that the injection of horse serum into such persons is a danger must certainly be taken into consideration in the use of antitoxin.

Discussion.

Dr. C. F. v. Pirquet.—Dr. Anderson did not tell you that his work with Dr. Rosenau was one of the most complete and valuable contributions to the subject. They were the first to establish a quite definite test as the basis of their investigations: the immediate death of a guinea pig at the second injection of horse serum and other substances. And with this test, they investigated in numerous and painstaking experiments one question after the other. Everything Rosenau and Anderson have established stands firm. Anderson's special work was about the transmission of anaphylaxis to the offspring. His experiments are quite clear, but as to the conclusions which he mentioned in regard to tuberculosis, I am not fully of his opinion. If an inherited tendency to tuberculosis is due to a transmission of anaphylaxis, we ought to find a positive tuberculin reaction in children of tuberculous mothers. This is not the case. Children of tuberculous mothers or calves of tuberculous cows give negative tests, except if they have acquired an active tuberculous lesion by infection. I do not believe in an inherited tendency: the frequency of tuberculosis among children of tuberculous parents is due to the great probability of infection in early age, if one of the parents suffers from an open tuberculosis.

II. Acute Pancreatitis and Urinary Findings. Dr. G. H. Whipple.

The report consists of two parts: the first dealing with the Cammidge reaction; the second with the presence of lipase in the urine. The experiments were performed by four men—Mr. Chaffee, Mr. Fisher, Dr. King and Dr. Whipple, and by various repetitions and controls the personal equation was eliminated.

Acute pancreatitis was produced in dogs by the injection of 4 or 5 cc. of pig's bile into the large pancreatic duct. Visible ecchymoses appeared within five minutes after this injection and together with the bile-stained edema, indicated the extent and severity of the lesion which developed very rapidly. The Cammidge test "C" was used in all the experiments. Both catheterized and filtered cage urine uncontaminated with feces were used and no difference noted in these types. All the animals with acute, hemorrhagic pancreatitis gave a positive Cammidge test with one exception: the crystals obtained corresponded in morphology and solubility to those described by Cammidge.

Animals poisoned with chloroform as a rule gave a positive Cammidge reaction. Such animals were suffering from extensive necrosis of the liver, and it was thought that the necrosis of the liver cells was responsible for the positive test.

Two animals suffering from bronchopneumonia gave a positive Cammidge test. A piece of pneumonic dog's lung was hydrolized with five per cent sulphuric acid for two hours, neutralized with barium hydroxide, and the clear filtrate injected into the peritoneum of dog whose urine previously gave a negative Cammidge reaction. This animal's urine after the injection gave a very beautiful Cammidge test; and the test persisted in the animal's urine for one week. At the end of this time operation showed a normal peritoneal cavity, pancreatic, liver, spleen, and kidney tissue.

A second experiment using 250 g. of a human pneumonic lung (gray hepatization) was performed, (hydrolysis for six hours with five per cent sulphuric acid, neutralization with barium hydrate and concentration of the clear liquid to 500 cc.). Fifteen cc. of this concentrated extract injected intraperitoneally gave a positive Cammidge reaction in the urine of an animal which previously was free from the reaction. The Cammidge test applied to the fluid itself gave a positive reaction. Routine examination of dogs in the laboratory showed a positive reaction in a few perfectly normal female dogs, in one dog shortly after pregnancy and in other dogs recovering from extensive operations not involving the pancreas.

The Cammidge test was applied to several patients who afterwards came to post-mortem examination. One case suffering from an abscess of the pancreas gave a positive reaction. A second case of acute leukemia gave a positive test; but the pancreas at post-mortem was found to be normal. A few cases of clinical chronic pancreatitis gave a positive test. These results could not be controlled by post-mortem examinations.

It is evident from our experiments that the Cammidge test is not specific for acute or chronic changes of the pancreas. The disintegration of any cells in the body may give the reaction or even artificial hydrolysis of any animal tissue may give substances which will appear in the urine and give the characteristic crystals. It is possible that the disintegration of the polymorphonuclear leucocytes is an important factor in the production of this unknown substance. Determination of the melting point of purified crystals does not correspond with the reports given by Cammidge. The melting point was found at about 140° C.

PART II.

The presence of Lipase in the Urine.—Catheterized urine was used in all experiments, and the same series of animals was studied for this reaction. The technique of the test has been recently described by Drs. Winternitz and Meloy. The reaction depends on the ability of the ferment lipase to split ethyl-butyrate with the setting free of butyrate acid which is estimated by titration with 1/20 normal sodium hydroxide. Litmus is used as an indicator.

In animals suffering from acute hemorrhagic pancreatitis, this ferment is constantly present in the urine, most marked for the first three days, but present usually for a week. After anesthesia (ether or chloroform), this ferment appears in the urine after a few minutes of anesthesia and persists some hours after the anesthesia. It is present in a considerable amount. This is not due to a rise of the serum lipase which remains practically constant, and must be due to the increased permeability of the renal epithelium allowing the escape of this ferment.

Ligation of the body of the pancreas causes the appearance of a small amount of the ferment in the urine, and the condition persists for one to two weeks. The ferment does not appear in the urine in cases of acute peritonitis; for example, due to the rupture of a distended gall bladder. Animals with jaundice or pneumonia do not give the reaction. Many normal dogs have been examined, and the reaction was negative in all but one. This animal was in the late weeks of pregnancy, and this may explain the finding.

A few human cases have been examined, and the reaction was negative in all except one diagnosed as probably a large abscess in the region of the pancreas. The ferment was present in the urine in very small amounts only for three days following the operation and drainage of this abscess cavity. It is believed that the examination of the urine for this ferment may be of value in cases of acute hemorrhagic pancreatitis, particularly at onset.

March 11, 1910.

Special Meeting.—The Johns Hopkins Hospital Medical Society in conjunction with the Neurological Section of the Medical and Chirurgical Faculty. Dr. Louis Hamman in the chair.

I. Studies in the Comparative Development of the Nervous System. DR. STEWART PATON, Princeton, N. J.

In a most interesting talk Dr. Paton reviewed his recent observations made in the study of the egg of the scyllium canicula, a species of Mediterranean shark. By means of a small fenestra made in the capsule of the egg the growth of the embryo could be made while the egg was kept in the natural environment.

The first movements observed consisted in a slight motion of the head and tail of the embryo, which began when the embryo reached the length of 4 mm. Three days later a slow peristaltic motion of the heart was noted. The movements of the heart are affected by the temperature of the water and also by the addition of sodium chloride up to one and three per cent solutions. The addition of urea to the water has a marked stimulating effect for the adult heart but not for the embryo heart.

Up to the stage where the embryo reaches the length of 5 mm. no nervous system is present from an anatomical standpoint. Still certain reactions are present which may fall into the class observed in the medusa. Cocaine in very large doses has no effect upon the movements of the embryo below the 7 mm. stage, but above this stage the drug exercises its characteristic effects.

Between the 9 and 14 mm. stage, when the heart is excised, very little effect is noted upon the swimming movements of the embryo. The sympathetic nervous system is supposed to be differentiated at the 14 mm. stage. According to Loeb the nervous system acts simply as a regulator and absolutely no specific quality can be ascribed to it. The guiding effect of the nervous system comes on at the 14 mm. stage and at that time autonomy asserts itself. As early as the 4 mm. stage, at a time when there is no evidence of any cardiac activity, an unbroken tract of protoplasmic cells can be made out extending from the myotome to the spinal column and from the spinal column to the (ectoderm) periphery. These tracts seem able to conduct impulses at this stage, still it is impossible to pick out just which cells are destined to become nerve cells. It is thought that these complicated nervous tracts exist in a physiological sense long before any anatomical destruction of nervous tissue can be made out. It is not until the embryo reaches the 6 mm. stage that the vagus nerve reaches the heart; up to this time the heart has been beating uninfluenced by the nerve.

II. The So-called Thyroid Carcinoma of the Brook Trout and its Relation to Ordinary Goitre. DR. DAVID MARINE, Western Reserve University.

Opportunity was offered to Dr. Marine to study the occurrence of thyroid enlargement in brook trout and other species of fish in the Michigan State Fish Hatcheries. In the ponds

and tanks of these hatcheries, a large number of fish were found to be affected with hyperplasia of the thyroid; often more than half the number of fish were found thus affected in several of the ponds.

Certain associated changes were noted in these goitrous fish. The fish were noted to be large for their age, excessively fat and as a rule showed excess of skin pigment. Pigment was also found present in the thyroid and internal organs. Constant enlargement of the spleen and lymphoid tissue was observed just as is so often seen in mammalian goitre. Careful study was made of the habitat of the fishes, the flora of the ponds, the effects of increase and decrease of the water supply: and the nature of the food furnished was also thoroughly investigated.

Inoculation experiments were tried but all gave negative results. The question of therapy was taken up and various strengths of iodine solution were supplied to the affected fish and marked changes were soon to be noted. Iodine was found to have a specific action on the hyperplasia of the thyroid tissue; i. e., the hyperplasia ceased and the gland showed colloid accumulation, the blood supply to the gland was reduced and the blood vessels underwent a type of obliterative endarteritis.

The following will serve as a summary of Dr. Marine's views concerning the carcinomatous nature of this hyperplasia. Is this thyroid hyperplasia true carcinoma? In view of the facts that young fish are more affected than old fish; that iodine stops the hyperplasia and causes it to return to the colloid state; that removal of the fish from the ponds to the open brook also effects a cure; that the clinical incidence of tumors is directly related to the water supply; that the severity of the disease as determined by histological examination is likewise directly related to the water supply, we cannot accept the prevailing opinion that the disease is true cancer. On the other hand we believe that the disease as studied by us is an extreme illustration of endemic goitre, the end stage of which is cretinism. The opinion that it is cancer is based purely on anatomical studies—the essential fact being that the growing thyroid invades bone, muscle, etc. Such findings in mammalian tissues are strong evidence of malignancy but this standard cannot be applied to fish thyroids for the reason that any growth of a widely and loosely distributed nonencapsulated gland would give the histological appearance of invasion of the surrounding tissues.

Discussion.

Dr. H. R. Gaylord.—This disease is found in the stock waters of New York, the disease is quite common, and factors enter into its occurrence which do not belong to the conditions found in fish hatcheries alone.

Young fish are undoubtedly much more susceptible to the disease than the older fish. I do not believe that spontaneous recovery is any evidence that the growth is not of a malignant nature, nor do I think, at the present time, a therapeutic test such as suggested by Dr. Marine will supplant the microscopic test. The standard of encapsulation is not entirely satisfactory and in our observations in cancer in rats we often find that rapidly growing soft carcinomatous growths change over into a less malignant form and show marked adenomatous changes.

NOTES ON NEW BOOKS.

An English Handbook to the Paris Medical School. (With Map.) By A. A. Warden, M. D. Second edition. Price, 50 cents. (*Philadelphia: P. Blakiston's Son & Co., 1910.*)

This small paper-bound volume contains chapters on post-graduate work in Paris, the faculty of medicine, the hospitals, and other subjects of interest to the prospective student in the city. It is neatly and compactly arranged, and most serviceable for those thinking of going to Paris to study.

A Text-book of Physiology: for Medical Students and Physicians. By William H. Howell, Ph. D., M. D., LL. D., Professor of Physiology, Johns Hopkins University, Baltimore. Third edition. Thoroughly revised. Price, $4.00. (*Philadelphia and London: W. B. Saunders Company, 1909.*)

A detailed review of this text is uncalled for. We may observe with satisfaction that the revision of the book has fully justified the short interval which has elapsed since the last edition appeared. The problem of altering the presentation so as to include the more recent advances in physiology without a corresponding increase in the number of pages is no simple one, and the author is to be congratulated upon the success with which this has been done. Among the more recent contributions incorporated in this edition may be mentioned the application of Einthoven's string-galvanometer to physiological problems; the investigation of physiological processes whether they be chemical or physical according to their temperature coefficients after van't Hoff's law; the newer work on the coagulation of the blood; the physiological importance of the venous blood pressure and Rubner's work on nutrition and growth.

A Text-book on the Practice of Gynecology. By William Easterly Ashton, M. D., LL. D., etc. Fourth edition, revised and enlarged. Price, $6.50 net. (*Philadelphia and London: W. B. Saunders Company, 1909.*)

This new edition of Dr. Ashton's well-known work presents numerous alterations and revisions. The general plan of the book has not been changed, however, and it is pleasing to note that the same wealth of detail, clearness, logical arrangement of subject-matter and comprehensiveness which have made previous editions so acceptable both to practitioners and students are conspicuously in evidence in this one. The author happily assumes throughout an entire ignorance on the part of the reader of the subject-matter under discussion; and if, on this account, many paragraphs seem elementary in character and superfluous to the experienced specialist, this objection is fully offset by the judicious use of bold type, which renders selective reading quite easy, and by the further important consideration that an authoritative opinion on detail is made accessible to the beginner.

Medical gynecology is very fully and satisfactorily considered, a feature of the book that should prove very attractive to many practitioners.

The chapters on certain diseases of the urinary system, on

ectopic gestation, on shock, and on peritonitis are among the more important ones that have been fully revised in accordance with recent advances.

The illustrations are numerous and, while not of high artistic merit, yet are, for the most part, clear and accurate, and constitute an important adjunct to the text.

The book can be safely recommended as an authoritative work on gynecology that justly deserves the widespread recognition already accorded it.

E. H. R.

A Text-book of the Practice of Medicine. By JAMES M. ANDERS, M. D., etc. Ninth revised edition. Illustrated. Price, $5.50. (*Philadelphia and London: W. B. Saunders Company, 1909.*)

The appearance of a ninth edition of Anders' Practice is evidence that there is a demand for the book. In reviews of former editions we have commented on the lack of originality of method and aptness of presentation in this work, a fault shared by many other similar compilations. This new edition has been rewritten in parts, but maintains the same general character. The illustrations are rather disappointing, especially the color work.

The Elements of the Science of Nutrition. By GRAHAM LUSK, Ph. D., M. A., F. R. S. (Edin.), Professor of Physiology at Cornell Medical School, New York. Second Edition, revised. (*Philadelphia and London: W. B. Saunders Company, 1910.*) Price, $3.00.

"This, the second edition, differs chiefly from its predecessor in containing facts which have been brought to light during the past three years." In the March, 1908, number of this journal this work was warmly reviewed, and it is merely necessary to call attention once again to this most excellent work. No better book of its size exists in English.

Esquisses cliniques de Physicothérapie, Traitement rationnel des Maladies chroniques. PAR LE DOCTEUR J. A. RIVIÈRE, etc. (PARIS: *Imprimerie Brucky et Cie., 1910.*) Price, f.7.50.

Dr. Rivière is a very ardent advocate of mechano, electro and hydrotherapy in all their forms, and there is no doubt that those who have carefully used these methods of treatment do secure results with them which others who use them but seldom rarely obtain. But it is doubtful whether the results are always so brilliant as the author would seem to claim, and whether the explanations of their physiological actions is based on more than pure hypothesis; and, finally, whether physicotherapy is of real value in as many different diseases as the author believes. The author's style is not as clear and simple as that of most French writers, and the book is not, therefore, easy reading, but deserves consideration because of the author's professional standing. Though his views may not always be sound, yet those with open minds, anxious to learn the value of physicotherapy will do well to look over this work.

The Medical Annual. A Year-Book of Treatment and Practitioners' Index, 1910. 28th year. (*Bristol (Eng.): J. Wright & Sons.*) Price, 8/6.

This English annual is one of the best published. It has a large staff of well-known English surgeons and physicians, two from Philadelphia, Ashhurst and Deever, and Novak, of Baltimore. The collaboration of these men furnishes the profession with a useful and well-illustrated manual, which contains more general information rather of use to English than foreign practitioners than any other work of this nature. The contents are so numerous that any abstract of them would give but a poor idea of the variety of subjects treated, but one paper deserves special attention, "Sea-Water Treatment," by S. Robert Simon, M. D., of Paris. The value of injections of sea water is certainly very remarkable if one may judge from the accompanying photographs of patients before and after treatment.

Department of Neurology, Harvard Medical School. Vol. IV. (*Boston, Mass., U. S. A., 1910.*)

This volume contains 12 neurological papers on widely different subjects, which have all appeared either in the Boston Medical and Surgical Journal, the Journal of Nervous and Mental Diseases, or elsewhere. The authors are Knapp, Taylor, Putnam, Waterman and Patch. Such collections are of value in all medical libraries, as they are more easily consulted than the various journals which are frequently missing.

The Sexual Life of Woman in its Physiological, Pathological and Hygienic Aspects. By E. HEINRICH KISCH, M. D., Professor of the German Medical Faculty of the University of Prague, etc. Only authorized translation into the English language from the German, by M. EDEN PAUL, M. D. Illustrated. 1910. (*New York: Rebman Company.*) Price, $5.

This work is divided into three parts: the Sexual Epoch of the Menarche, the Sexual Epoch of the Menacme and the Sexual Epoch of the Menopause. "By 'menarche' the author means the period of life when menstruation as a sign of puberty first makes its appearance, and by 'menacme,' the culmination of the sexual development of woman, during which the processes of reproduction, copulation, conception, pregnancy, parturition and lactation occur." Both French and German writers have devoted more attention to the sexual side of life in both sexes and its influence on moral and physical development than have Americans and Englishmen. To the latter the subject is often distasteful, and they have not as thorough a knowledge of its importance as they ought to have. This book is only one of very many dealing with the subject and will doubtless find interested readers, even in spite of its size. It is discursive rather than profound and is hardly as the author states "a contribution towards the solution of the sexual problem," at least the solution does not appear any nearer after reading the book. The writer has collected much material and writes with a serious purpose, though as in almost all these works there is at times an unpleasant note, but on the whole he has handled a difficult subject as well as most.

Male Diseases in General Practice. By ELDRED M. CORNER, M. C., B. Sc., F. R. C. S. (*London: Oxford University Press, 1910.*)

This moderate-sized book, of about four hundred and fifty pages, fulfills its mission, as announced in the title, quite well. Dealing entirely with diseases of the male it includes only the urethra and no more of the urinary apparatus. The chief criticism of the work should be directed against the brief manner in which the prostate and its conditions are dwelt upon, as well as the verum montanum, both of which deserve more attention if we are to judge by their frequent involvement in pathological processes and the sometimes obscure symptoms of which they are the cause. The chapter on the urethra is hardly as full or as broad as one would expect to find in a book devoted to male diseases, particularly in regard to treatment. The chapters on the external genitalia are full and very excellent. Altogether, with large type and an easy style, it is a pleasant book to read as well as one worth the while of even a very busy practioner.

M. L. B.

Proceedings of the Imperial Malaria Conference, Held at Simla, in October, 1909. (*Simla: Government Central Branch Press, 1910.*)

The importance of malaria as a health and life-destroying factor in the East is evidenced by the calling of this conference, and the publication of its proceedings. Malaria is now so well controlled

in this country that it is hard to believe in the enormous mortality still caused by it in certain parts of the world. By students of hygiene, and others interested in malarial questions and problems, this report will be read with care, for the work done by English government officers, both lay and medical, along broad hygienic and scientific lines is of such high quality, that their writings cannot be neglected if one desires to be well informed on the matter in hand.

New and Nonofficial Remedies, 1910: Containing descriptions of articles which have been accepted by the Council on Pharmacy and Chemistry of the American Medical Association, prior to Jan. 1, 1910. Price, paper, 25 cents; cloth, 50 cents. 256 pages.

This is the second year of the publication of this work, and practitioners and pharmacists should welcome it warmly, for it contains in compact form information difficult to find without long search. Many of the drugs described are much used, so that it is all important for a doctor, who desires to use them, to be able to find readily, as he here can, an accurate description of them. The names of the compilers, who are all highly trained scientific men, gives the work a stamp of thoroughness and value.

Handbook of Therapy. (Chicago: American Medical Association, 1910.) Price, $1.50.

This is a new venture on the part of the directors of the American Medical Association. For the use of the general practitioner and medical student there has been culled from the journal of the association the most important matter on therapeutics which has appeared in it in the past few years. Here are brought together the views of all classes of doctors at home and abroad on various drugs and treatments. Such a compilation has its advantages as well as its disadvantages, but the latter would seem to outnumber the former, and render the book of little real value to the medical student. For the general practitioner it may prove more serviceable, but the handbook cannot really prove of great service to any one, for it is not sufficiently authoritative. In therapy the experience of the best masters is wanted perhaps more than in any other branch of medicine, that harm may not be done the patient, and so it would be wiser when in trouble to turn to the leading works on therapeutics rather than to this small manual.

Progressive Medicine. Edited by Hobart Amory Hare, M. D., etc., assisted by H. R. M. Landis, M. D., etc. Vol. I. *(Philadelphia and New York: Lea & Febiger, 1910.)*

The contributors to this volume are Frazier, Ruhräh, Crandall, Kyle and Dent, and their respective chapters on Surgery of the Head, Neck and Thorax; Infectious Diseases, including Acute Rheumatism, Croupous Pneumonia and Influenza; The Diseases of Children; Rhinology and Laryngology; and Otology are all well prepared. Abstracts of the leading articles on these subjects are presented and references given to others, and each contributor adds something of value by expressing his own opinion upon the questions discussed.

The Propaganda for Reform in Proprietary Medicines. Sixth edition: Containing the various exposes of nostrums and quackery which have appeared in The Journal of the American Medical Association. Price, paper, 10 cents; cloth, 35 cents. 292 pages. Illustrated.

The value of this small book is shown by the fact that this is its sixth edition, and we hope that many more editions will be called for. The more it gets into the hands of the intelligent laity the better. Our people need to learn the uselessness and harm that may come to them from taking proprietary medicines which are, in the great majority of instances, nothing but pure frauds. The drugs are expensive and the people waste their earnings in buying them besides oftentimes irreparably injuring their health. The general practitioner should study these reports so that he may clearly point out to his patients the folly and danger of using medicines and preparations which may lead to drunkenness, the opium or cocaine habit, or render operations as in the case of cancer quite impossible from the delay caused by using these quack remedies in the hope of a cure. With the help of such authoritative publications little by little the laity will learn that the advice of a good physician is worth far more than a bottle of medicine bought at a drug store, which has nothing to recommend it except false and lying statements made by its manufacturer.

International Clinics. Edited by Henry W. Cattell, M. D. Vol. I. Twentieth Series, 1910. *(Philadelphia and London: J. B. Lippincott Company.)*

Three papers on the serum diagnosis of syphilis, one of them by Hideyo Noguchi, who is known for his special work on this problem, two on pellagra, with excellent illustrations, and one on purin metabolism, show how successfully the editors succeed in keeping these clinics up-to-date. Men working in different specialties will find other papers to interest them.

Living Anatomy and Pathology. The Diagnosis of Diseases in Early Life by the Roentgen Method. By Thomas Morgan Rotch, M. D., Professor of Pediatrics, Harvard University. Illustrated. 1910. *(Philadelphia and London: J. B. Lippincott Company.)* Price, $6.

This handsome work, dedicated to Dr. William Osler, is a most valuable contribution to pediatric literature, and no student of children's diseases can well afford to be without it. The collection of X-ray photographs is unique and a careful study of them will repay any physician. These illustrations show normal and diseased conditions from the first to the sixteenth year, supplemented by brief explanatory notes, and longer chapters dealing with the diseases of the different portions of the body described. No other work of the kind exists, and this one will always remain an authority, for it can be improved only by further additions. Dr. Rotch is to be congratulated and complimented on presenting the profession a work of such importance.

Pye's Surgical Handicraft: A Manual of Surgical Manipulations, Minor Surgery and Other Matters Connected with the Work of House Surgeons and Surgical Dressers. Fifth edition. Revised and largely rewritten by W. H. Clayton-Greene, F. R. C. S., etc. Illustrated. *(Bristol: John Wright & Sons, Ltd.; London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1909.)*

In the preface to the first edition published in 1884 the author says he has endeavored to describe the details of surgical work as it appears from the point of view of house surgeons and dressers in surgical wards.

In the revised edition an attempt has been made to maintain the character and style as originally adopted by Mr. Pye, and the reviser says that it has been his aim to complete a book which will cover most of the common details and complications of treatment occurring in the course of surgical practice.

The book is divided into ten sections as follows: 1, Of the Arrest of Hemorrhage; 2, Of Apparatus for Restraint and Support (Bandages, Splints, etc.); 3, Of Fractures, Dislocations and Sprains; 4, Of Wounds, Ulcers and Burns; 5, Of Cases Requiring Prolonged or Mechanical Treatment; 6, Of Minor Surgery and Kindred Subjects; 7, Of Special Cases Connected with the Head and Throat; 8, Of Certain Emergencies, Surgical and General; 9, Of the Administration of Anæsthetics; 10, Miscellaneous.

The chapter on Minor Surgery of the Eye is written by L. Paton; those on Head Injuries and Diseases of the Nose and Throat, Larynx and Ear, by W. H. Carson; The Treatment of

Cases of Poisoning and on Urine Testing, by W. H. Wilcox; Anæsthesia, by J. Blumfeld; and X-rays, by G. A. Simmons.

There are numerous illustrations, many practical suggestions, and the book is nicely gotten up. The descriptions are necessarily brief, but are for the most part clear.

This little hand-book will be more useful to house surgeons and surgical dressers, as originally intended by Mr. Pye, than to the operating surgeon. J. S. D.

Immunity and Specific Therapy. By W. D'ESTE EMERY, M. D., B. Sc. (Lond.), etc. Illustrated. (*New York: Paul B. Hoeber, 1909.*) Price, $3.50.

The author states in the preface that he has "attempted to give a connected and symmetrical outline of the chief facts definitely known with regard to the method in which the body protects itself against infections, and of their applications in the diagnosis, prevention and treatment of disease."

The text is preceded by an excellent glossary which serves a very useful purpose since many of the newer terms introduced in the recent studies in immunity are not defined in the ordinary medical dictionaries.

In the introductory chapter the author defines immunity and discusses the immediate and predisposing causes of infection and gives a brief historical review of the earlier theories of immunity.

The nature of toxins, the phenomena of antitoxin formation, the origin of antitoxin, and immunity to toxins are dealt with at considerable length and on the whole in a satisfactory manner, including a brief review of Ehrlich's Side-Chain Theory.

This arrangement is a fortunate one, as the toxin-antitoxin reaction is one of the simplest and at the same time one of the most studied and perhaps best understood of the immunity reactions and going into detail, as the author does with this subject, prepares the way for the more complex reactions which follow.

It would seem a more logical sequence to have followed the chapters on toxin and antitoxin by a consideration of agglutinins and precipitins instead of, as the author has done, chapters on Bacteriolysis and Allied Phenomena.

Bacteriolysis and hemolysis are well treated and the conflicting views of Bordet and Ehrlich concerning the action of immune body and the unity or plurality of complement are fairly stated and much of the experimental evidence which each brought forward in support of his views is given, although it will perhaps be difficult for one unfamiliar with the subject to follow the intricacies of the experimental data and interpret intelligently the results.

The author very reasonably calls into question some of the evidence which has been brought forth for the existence of anti-complement.

The chapter on agglutinins is satisfactory and the discussion of the physical laws which may play some part in the phenomenon of agglutination is very interesting.

Precipitins are dealt with briefly and some very interesting phenomena in connection with them are omitted.

Phagocytosis is given lengthy consideration, largely from the standpoint of a partisan of Wright's opsonic theory.

In view of the great practical importance of the tuberculin reaction it is to be regretted that a more comprehensive exposition of this subject is not given.

The chapter on the Colloidal Theory of Antibodies is of great interest and is evidence of the present trend of immunity researches along physical and physico-chemical lines.

The text closes with a chapter on Practical Applications which consists largely in an exposition of vaccine therapy controlled by Wright's method of opsonic determination. The author frankly admits that in many cases the results are disappointing.

A very comprehensive and useful bibliography is given by chapters at the conclusion of the book, together with an index of authors cited and a subject index.

The books fills a much felt need and is the most comprehensive systematic treatise of the subject in English with which the reviewer is familiar.

A most serious fault is the great number of textual errors in which the book abounds. Such errors, for example, as the use of the word "leucocytes" where the word "bacteria" should have been used, "serum" for "corpuscles," "toxin" for "antitoxin," etc. In some places the mistakes are evident, but in others they would probably lead to utter confusion in the mind of one not already familiar with the subject.

These unfortunate errors will doubtless be eliminated in subsequent editions and it is to be hoped that the more recent work on the mechanism of cobra-venom hemolysis, and a fuller discussion of the Wassermann reaction and the subject of anaphylaxis will be included. W. L. Moss.

Nervous and Mental Disease. Monograph Series No. 6. Epidemic Poliomyelitis. Report of the Collective Investigation Committee on the New York Epidemic of 1907. (*New York: The Journal of Nervous and Mental Disease Publishing Company, 1910.*)

This admirable report is divided into five chapters, preceded by a brief introduction: I, Epidemiology of Poliomyelitis, by Drs. Boldman, Ager and Terriberry; II, On the Conditions Preceding Onset and the Early Symptoms of the Disease, by Drs. La Fétra and Schwarz; III, The Symptomatology of Epidemic Poliomyelitis, by Drs. Clark, Hunt, Jelliffe, Sachs and Zabriskie; IV, The Pathology and Pathological Anatomy of Epidemic Poliomyelitis, by Drs. Flexner and Strauss; V, Treatment of Poliomyelitis, by Drs. La Fétra, Jelliffe, Ager, Taylor and Sachs.

As is seen from these headings, the disease has been considered from the principal points of view, and each chapter prepared by capable subcommittees, with the result that this report must be carefully studied by all who desire to be masters of the subject of poliomyelitis. It is a report to appeal to both general practitioners as well as specialists in nervous diseases. The committee as a whole presents this clear, concise and thorough work which helps to throw light upon many conditions in the disease which have been obscure, and has made a really valuable contribution to the literature of an important disease.

Modern Surgery: General and Operative. By J. CHALMERS DACOSTA, M. D., Professor of Surgery and of Clinical Surgery in the Jefferson Medical College, Philadelphia. Sixth edition, greatly enlarged. Illustrated. (*Philadelphia and London: W. B. Saunders Company, 1910.*) Price, $5.50.

What was said favorably of this work in the February, 1908, number of this journal applies with still greater force to the sixth edition. The author by his frequent revision does not allow this successful surgery to become a work of the past, but by his additions and alterations makes it of still greater use to students and practitioners. The author forestalls criticism by his own regret and apprehension at the growth of the work. In the next edition perhaps he may be able to demonstrate his well-known surgical ability by removing certain portions of his "subject," so treating him that he is better after the operation than he was before. The excellence of DaCosta's work will make this difficult.

Some Common Remedies and Their Use in Practice. By EUSTACE SMITH, M. D., F. R. C. P., etc. (*New York: Paul B. Hoeber, 1910.*) Price, $1.25.

This small book is composed of "reprints of papers contributed to The British Medical Journal," and any practitioner who will read them with care and appreciation will get many valuable hints from them as to the correct and most effective method of prescribing certain drugs. They are admirable clinical lectures, and it is only a pity that there are not more of them. The seven chapters are entitled as follows: 1, On an unjustly neglected

remedy (tartarated antimony); 2, On the internal use of the oil of turpentine; 3, On the use and misue of iron remedies; 4, On the use of alkalies in practical medicine; 5, On antispasmodics and the care of spasm; 6, On some uses of opium; and 7, On the use of sodium salicylate in certain serous inflammations.

The Conquest of Disease Through Animal Experimentation. By JAMES PETER WARBASSE, M. D., etc. (*New York and London: D. Appleton Company, 1910.*)

It is to be hoped that this defence of animal experimentation may find its way where it will be serviceable, but unfortunately the author's ability to write a useful work on this subject is not as marked as his zeal in the cause. The book cannot be compared in value to Stephen Paget's more extensive work on this subject published a few years ago. There is some danger that this book will prove more advantageous to the antivivisectionists than to the defenders of experiments on animals, for some statements made are too sweeping, and it is carelessly written.

Ophthalmic Surgery. By CHARLES H. BEARD, M. D., etc. Illustrated. (*Philadelphia: P. Blakiston's Son & Co., 1910.*) Price, $5.

In this book are described practically all the operative methods adopted in present-day operative surgery on or about the eye. Much space is devoted to the subject of tendon advancement operations in the case of squint, and a full description of the tendon lengthening operation, as proposed by Stephenson, of London, is given. Considerable space is also given to the consideration of operations for ectropion, entropion, symblepharon and ptosis. It is probably just as well that we have a book in which descriptions of various methods of doing those operations are gotten together, although most operators will merely receive suggestions from them and adopt a more or less original means of dealing with their own cases. The operations spoken of above are described with very much more fullness than in the ordinary text-books, but in the description of the more important and certainly more frequently performed operations, such as cataract extraction, probe passing, iridectomies for glaucoma, and the rather important lid tumor operations, there is not the authoritative tone met with in less pretentious books. To anyone devoting much attention to plastic surgery about the eye, this book would probably be of interest, but as a whole it is not a volume of great merit. Making extravagant statements to drive an idea of the author home, such as: "Lack of aseptic precautions oft turns into *abject failure* the most *brilliantly executed* surgical measure, while attention to them can make a *perfect triumph* of a *wretched bungle*" (page 1) and "It is *becoming so universal* for ophthalmic surgeons to be *ambidextrous* that it now looks almost like a confession of inferiority for one to stand at the left side of the patient, for instance in making a corneal section for cataract in the left eye" (page 114), is an unpardonable fault in a medical work. The descriptions are not always clearly written, and the grammar is often bad. B. B. BROWNE.

Diseases of the Heart. By JAMES MACKENZIE, M. D., M. R. C. P. Second edition. (*New York: Oxford University Press, American Branch, 1910.*)

The fact that one edition of this book has been exhausted within a year is gratifying evidence that the medical public has awakened to the importance of graphic methods in the study of cardiac diseases. The particular value of the book lies in the fact that the author has made careful physiological studies upon more patients than any other writer in the history of medicine. Like the first edition of the book, the second is not a text-book of heart diseases, but deals entirely with the author's own studies upon the venous pulse, illustrated with an unparalleled wealth of original tracings.

The author says, "The interpretation of these tracings represents the present state of my knowledge," and with exceptional liberal-mindednes writes, "Should other investigators prove these interpretations wrong by the discovery of new facts, I shall rejoice with them." However, since both editions contain the statement that the carotid origin of the *c* wave "is the main, and for practical purposes the only one, that need be considered," it must be admitted that he does not deem any work contradictory to his own as worthy of a hearing, even when the majority of clinical and experimental observers side against him. Such dogmatic statements are found throughout the book, often at the expense of scientific accuracy. The author has made little attempt to present the experimental evidence upon which interpretations of the venous pulse are based. He still invokes the "nodal rhythm" (impulses arising in the atrio-ventricular bundle) to explain all forms of disturbed rhythm in which there are no signs of auricular contraction.

The fascinating conversational style is retained and renders the book easy reading, but one often regrets that the author has made no attempt to analyze and tabulate his vast number of carefully studied cases for the benefit of the reader, and that he does not bring the cases of functional disturbances which he has studied so carefully into closer relations with the chapters on prognosis and treatment. One would naturally expect that in a work of this kind the pathological and prognostic significance of extrasystoles and of the absolute arrhythmia would be discussed in sufficient detail to enable the reader to view his own cases in the light of Mackenzie's experience; and that, if absolute assertions were not warranted, at least a statistical summary of the author's cases might be given. Unfortunately, however, this has not been done; and the reader is left to shift for himself or to rely on the facts revealed by simple physical diagnosis in the handling of his own cases; so that, in some ways the book blights the very hopes which it has aroused, though never the interest which it has awakened.

Most of the remarkable statements found in the first edition are perpetuated with equal positiveness in the second. Treatment is dealt with a little more fully than in the first edition. The Spa tratment is characterized chiefly as a "holiday," and the effect of CO_2 baths is not even considered. The restriction of salt in diet is briefly designated as "foolish." On the other hand Mackenzie gives a very interesting account of his own studies upon Hill's oxygen inhalation with a tight mask. The chapter on digitalis deals chiefly with the changes in rhythm due to over-doses rather than with the effect of the drug in therapeutic doses. One is surprised to find that the most modern phase of cardiac treatment, the intravenous strophanthin injection, is still unmentioned.

An excellent short chapter, by Thomas Lewis, upon the electrocardiogram, constitutes one of the great improvements in the new edition, though Mackenzie does not incorporate this phase of the subject in his own discussions. Blood pressure observations are often mentioned, but the important studies with the X-rays and the graphic studies upon the heart sounds are still ignored, so that the author cannot lay claim to any completeness in presenting the modern aspects of heart diseases, but only of having presented one phase of them.

The second edition is printed on lighter paper than the first, making it a thinner volume in spite of the greater number of pages. The reduction in price is also certain to improve its sale. A. D. H.

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